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Science & Technology

Central Eurasia

May 1996

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Science & Technology
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Russian Academy President Responds to Government Directive on Reorganization

964D0585A Moscow POISK in Russian
No 8 (354), 17-23 Feb 96 p 3

[Interview with Academician Yuriy Sergeyevich Osipov, president, Russian Academy of Sciences, by correspondent Yelizaveta Ponarina: "They Survived Until February. What's Next?"; the first three paragraphs are an introduction]

[FBIS Translated Text] *At one of the recent sessions of the Russian Academy of Sciences (RAS) Presidium, a communication was read indicating that by mid-February a finalized resolution on the matter of updating the network of scientific institutions would be presented to the Russian Federation Ministry of Science and Technical Policy. Thereafter Yu. Osipov, at a session of the State Commission on Science and Technical Policy, was to tell how the section of the government resolution (see POISK, No. 19, 1995) pertaining to the Academy of Sciences had been implemented.*

Discussions on this subject have already been going on a long time (see POISK, No. 24, 1995 and Nos. 1-6, 1996), giving rise to more and more questions and doubts. People from the reserve of the "high command of science" — academicians of world renown and an all-Russian influence — are entering into the struggle for the future of their institutes. But for the time being it seems that not one major academy institute in the country has been lost.

Our correspondent turned to Academician Yuriy Osipov, president of the RAS, with a request to shed light on the situation.

[Ponarina]: Yuriy Sergeyevich, how has the RAS decided to improve the structure of its institutions after issuance of the government directive?

[Osipov]: We will not take the government resolution as a point of departure. During the last four years we have been striving to adapt our network to the changing situation. So there is no need to think that the work is being done formally and only after appeals have been addressed to us.

The updating of the network of scientific institutions obviously must be handled to reflect the most important priorities in the scientific-technical development of the country. These priorities, in turn, must — and I spoke about this at a session of the Council on Scientific and Technical Policy under the president of the Russian Federation — have as a point of departure the national goals of the state, its place in the modern world; they must take into account our deep cultural-historical traditions. For Russia, such a priority at the present time and in the foreseeable future unquestionably is fundamental research in the fields of mathematics, natural and technical sciences and the humanities. This does not mean that the priority itself and the organization of undertakings associated with it is something chiseled in stone, once and for all stipulated and untouchable. Not at all. Specifically, updating the network also means both choosing and correcting the research direction and properly assigning emphasis (including resources) in research fields, and searching for new suitable forms of organization of work and shutting down and starting up scientific subdivisions and fields associated with this and much, much else. All this must be done under conditions of the strictest material restrictions.

The most difficult part, for understandable reasons, is abolishing various subdivisions. For example, we have subdivisions with highly qualified people whose initial purpose and mission do not fully fit into today's academy structure and the nature of whose activity is more suited to other departments. An example of this is the Center for Program Research, established in its day for the solution of special problems. Now the state is not asking us to solve such problems, but the highly qualified center specialists can successfully work in the interests of the Space Agency. This agency is actively working, and we are transferring the center there. There are other examples. During recent years, for different reasons we have shut down tens of laboratories, and sections and have transferred some institutes to other structures. But new subdivisions also have been started up, following the logic of development of science.

An important part of our work is the search for new forms of work organization. They are different, but all are directed at enhancing the efficacy of work, conserving and searching for new resources, and retaining personnel. For example, in some cases we have brought together and are bringing together related institutes into combined institutes. Another example is the establishment of international institutes on the basis of our institutes. This is being done particularly successfully in the Siberian Department. In this way, in particular, it is possible to reduce the brain drain considerably. Still another example is the setting up, together with leading institutions of higher education, of joint research institutes, centers, laboratories, sections, instructional schools, colleges, and departments. Here our resources are being brought together with those of institutions of higher education, and closer integration is favoring the attraction of young people into science. This is extremely important.

To be sure, bringing the network of scientific institutions into better order is being dictated at the state level

primarily due to resource considerations. However, such a formulation of the problem must not be abstract, but emanate, as already mentioned, from the priorities of national development. From this point of view, the preservation of fundamental science is the most important state mission. If we now thoughtlessly cut back scientific academy subdivisions, firing specialists from their jobs, in the immediate future we will lose the ground from beneath our feet — the very basis on which Russian branch science, industry and the economy will be able to rise up. There also can be no talk of any large-scale reductions in the academy sector of science. We have already sustained considerable losses: The total number of specialists in the academy has been reduced by approximately 20-23 percent and the number of scientific specialists by 12-13 percent.

[Ponarina]: Nevertheless, funding is being reduced from year to year.

[Osipov]: In actuality, since 1990 the funding has been reduced sixfold. Although for some institutes with an experimental orientation the decrease has been tenfold. We had scientific research institutes where special orders brought in up to 70 percent of all the funding. At that time no one thought that one fine day this money could come to an end. And it was not a matter of the pay received for the work. There were times when the scientists received little money, but work conditions were created for them. A first-class experimental physicist cannot carry out his experiments on his lap. But now we have reached the limit — having held out for four years on old supplies of equipment, materials and reagents, we are finally impoverished. Therefore, the academy can no longer withstand any perturbations which in any way would aggravate the situation. Quantitative changes are being transformed into irreversible qualitative changes.

Under these conditions, our remaining safety net is qualified people. That is why we, I repeat, are against a massive cutback. We are not defending a department but are taking national considerations into account. A very dangerous thought has taken root among people during recent years that it is for the most part individual scientists who must be supported — that so-called selective support should be made available. Real science is conducted in an extensive scientific environment, especially in Russia, where among the national traditions there are the scientific schools which are guardians of the spirit of research and the custom of collective work. Ask any scientist and he will recall the seminars, conversations at the university and at the institute where valuable ideas were discussed and kicked around collectively and matured. In other countries that is by no means the case. There the individualism principle can be seen clearly. The preservation of the scientific environment in Russia is therefore equivalent to the preservation of science in the country, together with the preservation of clearly defined scientific schools.

It is impossible to preserve and develop scientific schools without attracting young people. There is not now a more important task than to eliminate the gap between the generations of scientists developing during recent years in a number of scientific fields.

[Ponarina]: Yes, but the money and the conditions are lacking....

[Osipov]: But the basic conditions for success are established: first of all, interest in science among young people is being regenerated — admissions of students to some faculties has improved, competition for graduate studies has increased and more individuals have again begun to defend dissertations. And fundamentally new circumstances working in our favor have appeared — for example, a presidential decree has been signed providing that each year there will be deferments from being called into the army for 500 persons going to work in the RAS system after graduating from institutions of higher education. This event is more important for the academy than receiving 10-20 "extra" billions of rubles.

[Ponarina]: On what principle was the figure of 500 persons arrived at?

[Osipov]: This is approximately half the annual number of recruits to the academy. That's not many, but we can now keep the most capable ones in science, in the RAS system.

[Ponarina]: True, but they also need a roof over their heads and the wherewithal to live.

[Osipov]: That is why in a resolution of the RAS presidium it is necessary to set forth several other provisions: for example, on special stipends of RAS institutes for the best upper-course students at educational institutions, stipends of RAS departments for young scientists and on living quarters for young scientists. Academicians K. Zamarayev, N. Sobolev and N. Pokrovskiy wrote me a letter on this subject. I support this fully. An overall solution must be clearly thought through.

Now, about living quarters for young people: even from the small amount of money which we receive for capital construction we must allocate sums for the purchase or construction of quarters for young people. But we will make them available by contract. If a person proves himself, working a definite time at a scientific research institute, it is then possible to afford him the opportunity to purchase an apartment at an advantageous price or on

an installment plan or provide it free of charge. We will do this.

[Ponarina]: When? This spring, or after the general meeting?

[Osipov]: With respect to stipends — I think, beginning with the new academic year. This is up to the institutes and departments. With respect to the allocation of a definite percentage of housing to young people, we have already begun to do this. I repeat, the main potential of fundamental science is in young people.

[Ponarina]: You stated that the safety net has been exhausted, just a little bit more and everything will collapse if nothing changes. But hope sounded in your voice... What are you expecting, on what are you counting?

[Osipov]: It is necessary to be objective. On one hand, the state has done very little during these four years for science, but on the other hand, it has done much of that which could be done under these conditions. The Fund for Fundamental Research was set up? The Fund for Research in the Humanities? They were established. But these sums are coming from the same pocket — from the state. The academy is being supported, although obviously inadequately. If one speaks of the funding of the academy, one of the misfortunes is the irregularity of receipt of funds. If the budget approved by the Duma had been implemented as it was supposed to be, it would have been possible to avoid many critical, absurd and very painful situations. After all, scientific support and servicing must be planned — otherwise, our most important undertakings will be cut off, social stress will arise and many simply will throw up their hands.

[Ponarina]: To what extent was the budget for the past year fully implemented?

[Osipov]: By approximately 80-85 percent, but for science as a whole — by approximately 60 percent. Nevertheless, we took several fundamental steps. Purposeful all-academy programs were announced — such as programs for the support of stations, expeditions, instrument base, instrument making.... For better or worse, they not only were announced, but also, to one degree or another, implemented. The fact is that the funding during the past year, other than for the December failure, was more or less on schedule. It may have been inadequate, but it did come through.

[Ponarina]: The report circulated that publication of all the Academy's journals came to a halt.

[Osipov]: The publishing house is experiencing great difficulties — for some time the presses were stopped, but not one journal has come to a halt. All the principal structures are in operation. Now, after insistent appeals to the leaders of the country, the funding of the academy is shaping up. The president and the government have been able to assist the academy seriously. Incidentally, our own budget, even if it were completely fulfilled, would by no means cover our needs. We receive some funds from grants of the Russian Fund for Fundamental Research and the Russian State Science Fund, from Soros and other foreign grants. At some institutes, deductions from these grants go for general purposes.

[Ponarina]: But they were intended for the selective support of scientists!

[Osipov]: Correct, but in enjoying a grant a person works with the institute's equipment, in a room having at least some heat and light; in his institute's building there is water, telephone and sometimes E-mail, etc., etc. All these facilities cost money. Who will pay for them? The institute. Throughout the world, if a person receives a grant while working at a university, up to 50 percent of the sum is taken from the grant by the administration of this university, sometimes even 60 percent. But we, taking into account that our people are experiencing a very difficult situation, have set ourselves a standard — 20 percent. Although there are institutes where all the grant money is spent for the most part for all-institute purposes. For example, at the institute of Academician A. Skrinskiy. The specialists at his institute prefer to share the grants in order to maintain an environment in which everything "cooks," in which everything gets done.

[Ponarina]: And this does not give rise to disturbing undercurrents at the institute?

[Osipov]: I don't know. A. Skrinskiy is a fine young fellow, and I support him in this very much. In St. Petersburg there is a different situation with Zhores Ivanovich Alferov — there is a laboratory there, for example, in which the wages are several times greater than in other subdivisions. Is the scientific environment being destroyed thereby or not? To him it is clear. A. Skrinskiy shares the money, and that means that at his institute there is no ballast. But when, at a large experimental center money from grants is used to purchase an instrument with which others than the recipients of grants begin to work and many have an opportunity to demonstrate their skills, is that a bad idea?

Now there is discussion of the matter (I got a call from V. Kiselev, the vice prime minister) of establishing presidential stipends for doctors of sciences. A rather large sum was mentioned. I said it had to be given some thought — it was possible to shake up the entire system both within individual subdivisions and in the country

as a whole. It would be better to give money not for wages, but for the support of the scientific activity of this man, and accordingly, those who work alongside him: those handling instrument support, literature, publication of monographs, etc. Then, by supporting what's like individual "centers of activity," we would not allow the entire network of our scientific community to go under.

[Ponarina]: Nevertheless, cutbacks cannot be avoided, and that means there will be letters of dismissal and shutdowns. Do you not fear being dragged into these events even more than the swamp of shortages?

[Osipov]: A scientific council will solve the problem in each specific case. This is not just up to directors. The director must present proposals to the scientific council and ensure open discussion. Then there will be fewer sore spots, disturbing undercurrents and arguments. Cutbacks are occurring throughout the world, and in America, for example, programs for hundreds of millions of dollars are being shut down. Thousands of people are losing their jobs. We, especially with our difficulties, must reassess our values. But guided by those considerations about which I spoke at the beginning.

Russian Academy President Reports Achievements, Problems

964I00797A Moscow POISK in Russian
No 14, 30 Mar 96-5 Apr 96 pp 4, 5

[Article by RAN President Yuriy Osipov: "Working Off Old Reserves"]

[FBIS Translated Text] *As we reported in the last issue of POISK, the Presidium of the Russian Academy of Sciences held an expanded meeting in Moscow. Readers are acquainted here with the reports given by RAN [Russian Academy of Sciences] President Yu. Osipov and the academy's chief scientific secretary, I. Makarov.*

This year we retreated from a tradition written into the academy's charter: rather than an annual sitting of the general meeting, at which the results of the preceding year are supposed to be summarized, we are compelled to hold an expanded meeting of the academy presidium.

We are forced to do this out of financial considerations. The fact is that at the end of this year the term of the current membership of the academy presidium expires, and a sitting of the general meeting must be convened to elect a new presidium. We simply do not have the resources to conduct two sittings.

The reporting year was difficult for the academy, and similar in many ways to the last one. The academy's real financial activity continued to decline. As you know, financial complications peaked at the end of last year and in the beginning of this year, when financing established by the Law on the Budget for 1995 was cut off. From my point of view, unstable financing of academy science is no surprise in the critical economic situation in the country, given the production slump. According to the Russian State Committee for State Statistics the gross domestic product (GDP) decreased 4 percent in 1995 compared to 1994 (and this is in the presence of significant growth of the prices of products). The share of expenses on research and development in the GDP fell to 0.41 percent in the past year. Let me recall for comparison that this share exceeds 2 percent in the world's leading countries, while in the U.S. it has been holding stably at 2.6 percent over the last few years.

We know that budget appropriations to academy science cannot cover our needs, even if we received them in full. We get part of our resources from the Ministry of Science and Technology Policy for participating in state programs, and as grants from the Russian Fundamental Research Fund and the Russian Humanitarian Scientific Fund, as well as from foreign funds. Given continual growth of outlays on municipal services, scientific research in particular is finding itself without the needed financial support. This is why our institutes worked with the old reserves of equipment, materials and reagents over the last 4 years. These reserves are now nearing their end, and without a significant increase in the financing level, the academy will not survive. Quantitative changes may transform into irreversible qualitative changes. Recently I've been insistently telling this to the country's leadership.

From the Savings Bank of Accomplishments

Giving academy tradition its due, I would like to turn your attention to the year's most important scientific accomplishments. The academy's scientists produced world-class results in many directions of fundamental and applied research.

In Mathematics and Physical Sciences

A probability expression for a quantum Markov subgroup that is the minimum solution to the so-called control equation was found in research on evolutionary stochastic equations in Hilbert space at the Mathematics Institute imeni V.A. Steklov. This probability expression provides a new, powerful analytical tool for research on quantum evolutionary equations.

A source of ultracold neutrons based on solid deuterium was created with the VVR-M reactor at the St. Petersburg Institute of Nuclear Physics, providing a 1,230-time gain in the yield of such neutrons over conventional sources.

The frequency of the 1S-2S transition in the hydrogen atom was subjected to precision measurement with an accuracy exceeding earlier measurements by an order of magnitude at the Laser Physics Institute of the Siberian Department jointly with scientists of the Max Planck Quantum Optics Institute (FRG): this made it possible to determine the Rydberg constant with the highest accuracy permitted today. The measurements were made with a transportable ultrastable helium-neon laser stabilized with respect to transition of effectively selected cold metnane molecules. The absolute frequency of unperturbed transition of methane was measured to 14 significant places using this laser and the Max Planck Institute's optic clock.

A series of measurements of the position of the geodynamic station Simeiz were taken by the RAN Institute of Applied Astronomy and Institute of Space Research jointly with scientific institutions of Ukraine and NASA (U.S.). The measurements were made with subcentimeter accuracy using global networks of radiointerferometers with superlong bases joining together as many as 15 radio telescopes on all continents. The rate of tectonic movement of a reference point on the Crimean Peninsula was determined for the first time at 1.5 cm per year, which is consistent with models of global tectonics.

The Chernobyl disaster, which focused attention on the problem of nuclear power station safety, will have its 10th anniversary a month from now. In this connection I would like to mention conclusion of development of a concept by the Institute of Machinery Science jointly with the sector's special design office on the safety of newly planned nuclear power facilities that would preclude impermissible effects on the environment. This would permit us to draw up plans of atomic power stations with significant safety advantages over foreign stations.

A number of new scientific results were obtained in mechanics. One such result, associated with our understanding of the nature of destruction of materials during dynamic deformation, is a property discovered for fine-grained materials in the Siberian Department's Hydrodynamics Institute—that the instability of plastic flow and the locations of shear deformation and crack formation are independent of the material's crystal structure.

A method of visualizing three-dimensional objects in a complete solid angle of observation was developed by the RAN IPPI [Institute of Information Transmission Problems] in collaboration with the Information Processing Institute of the Australian Academy of Sciences. This work is based on a procedure proposed by the RAN IPPI for synthesizing digital display holograms. The synthesized holograms have no analogues in world science, and they allow the observer to look at a three-dimensional object from different sides by simply moving relative to the hologram.

A principle of mass-spectrometric analysis of microconcentrations of impurities in gases in real time when they are concentrated in the gravitational field of an ultracentrifuge prior to introduction into the mass spectrometer was proposed, tested and experimentally studied for the first time in world practice of analytical instrument making. The RAN Institute of Analytical Instrument Making developed several versions of complex units consisting of a concentrating centrifuge and a mass spectrometer. Concentration coefficients of up to 10,000 were attained with a single concentrator. A favorable decision regarding issue of a patent to Russia has now been received.

In Chemical and Biological Sciences

Successful experiments were conducted by the Siberian Department's Institute of Chemical Kinetics and Combustion on infrared multiphoton dissociation of a number of organic molecules using free-electron lasers, which in distinction from a carbon dioxide laser can tune to the frequency of any molecular vibrations. In particular, a more than 20-fold isotopic effect on natural carbon isotopes was observed for formic acid molecules.

A number of chemical institutes are successfully developing the work of creating original drugs and new principles of treating cancer.

Thus, it was shown in research by the Institute of Physiologically Active Substances that insect toxins contain substances with anticarcinogenic action—immunocorrecting anti-neoplasts. In particular, peptide components which produce an astoundingly high effect when compounded with synthetic additives was isolated from wasp venom. The increase in life span was 250 percent, with half of the animals surviving, even in experiments on recurring and metastasing tumors (which are especially difficult to treat).

The second phase of clinical tests on the anticancer drug Tsitoplastma created by the Institute of General and Inorganic Chemistry imeni N.S. Kurnakov was completed. This drug exhibited a more universal chemotherapeutic action and absence of nephrotoxicity in comparison with widely used Cisplatin. The same institute developed a means of obtaining hydroxyapatite of strictly stoichiometric composition, making it possible to significantly broaden its use in mandibulofacial stomatological treatment and surgery.

A procedure was introduced and production of a genetically engineered vaccine against hepatitis B was orga-

nized by the Institute of Bioorganic Chemistry imeni M. M. Shemyakin and Yu. A. Ovchinnikov jointly with the Kombiotekh Joint-Stock Company. The drug is not inferior in quality to a similar imported vaccine. According to the RF Ministry of Defense around 100,000 doses of the vaccine were supplied in 1995 for servicemen in Chechnya.

Scientists of the Human Brain Institute discovered that influenza virus disturbs permeability of the hematoencephalic barrier and induces appearance of cytotoxic microphages, which are capable of disintegrating and damaging nerve cells, and ultimately evoking nervous system disorders.

In Earth Sciences

For the first time in the world, scientists of the Institute of Geography created an electronic comprehensive geographic atlas titled "Nasha Zemlya" [Our Land] with the participation of scientists of Moscow State University and the U.S. The atlas contains 262 maps with information on development of nature and society, on earth resources and economics, and on the atmosphere and biosphere.

In the Humanitarian and Social Sciences

Efforts of research collectives and scientists of the History Department were concentrated on the comprehensive fundamental program "History of World Civilization and the Destiny of Russia." This year 317 monographs and collections of scientific articles were published, dozens of scientific forums were held, and archeological and ethnographic expeditions were conducted.

One of the main results of the year was further rethinking of the history of our fatherland, expressed in the desire of scientists to present this history free of any unscientific approaches and evaluations, to reveal it in all of its complexity and integration, and to determine its patterns. The work results were generalized in a three-volume book prepared for publication by several authors—"Ocherki istorii Rossii" [Notes on the History of Russia].

Institutes of the Department of Philosophy, Sociology, Psychology and Law are mainly conducting research under the program "Social, Political and Spiritual Renewal of Russian Society." Books published on this subject matter include "Rossiya v tsivilizatsionnom protsesse (mezhdu atlantizmom i yevraziystvom)" [Russia in the Process of Civilization (Between Atlanticism and Eurasianism)]; "Novoye varvarstvo kak problema rossiyskoy tsivilizatsii" [New Barbarism as a Problem of Russian Civilization]; the fundamental works "Reformirovaniye Rossii: mify i realnost" [Reform of Russia: Myths and Reality]; "Sotsialnaya i sotsialno-politicheskaya situatsiya v Rossii: analiz i prognoz" [Social and Sociopolitical Situation in Russia: Analysis and Predictions] and "Rossiya-95: nakanune vyborov" [Russia-95: On the Eve of the Elections]. The textbooks "Sotsiologiya" [Sociology] and "Sovremennaya sotsiologiya prava" [Modern Sociology of Law] were published for VUZes [higher educational institutions].

Scientific Institutions of the Economics Department completed fundamental and applied research in 1995 on formation and function of a socially oriented market economy. Over 400 scientific reports, analytical notes and expert opinions were prepared and sent to various state bodies and public organizations.

Among the most important studies of the problems of international security, mention should be made of work on the priorities of Russia's national security, relations in the Russia-U.S.-Europe triangle, and analysis of the paths and mechanisms of resolving existing and potential conflicts in Russian-American relations.

In 1995 the RAN Department of Literature and Languages continued its work on the fundamental research program "Domestic and World Spiritual Culture (Languages, Literature, Folklore and Art)."

The five-volume "Entsiklopediya 'Slovo o polku Igoreve'" [Encyclopedia "Tale of Prince Igor"] was published. The first and second volume of the facsimile publication "A.S. Pushkin. Rabochiye tetradi" [A.S. Pushkin. Working Notes] was published in connection with the approaching 200th anniversary of A.S. Pushkin's birth.

In 1995 the department's Russian scholars prepared and published a large number of different types of dictionaries. The fundamental "Slovar novykh slov russkogo yazyka" [Dictionary of New Russian Words] made its appearance. More editions of "Etimologicheskiy slovar slavyanskikh yazykov" [Etymological Dictionary of Slavic Languages] and other historical dictionaries were published.

Attention is Waxing, Money is Waning

Last year we felt greater attention and support toward academy science on the part of government structures. Thus, formation of the Council for Science and Technical Policy under the president of the Russian Federation and of a government commission on science and technical policy became significant events in the development of support to science and technology, as did publication of the government decree "On State Support to the Development of Science and Scientific and Technical Developments" on 1 April 1995, which set in particular the minimum level of appropriations for science—not

less than 3 percent of the expense side of the budget. It would be nice if this government decree were truly implemented, rather than just remaining on paper.

I would like to provide some information on a decision of the president of the Russian Federation. It was established in late 1995 in response to a proposal from the RF chairman of government that the academy president would participate in the government's work—in discussion and development of decisions—on equal terms with members of the government's presidium.

As we know, scientific research and other activity of our community, which serves as the center of fundamental science, is decisively determined by the level of resource support, chiefly financing. Last year, real budget appropriations to science continued to decline. The volume of appropriations allocated to the academy decreased by more than seven times in constant prices compared to 1991.

The Law on the RF Federal Budget for 1996 foresees allocating 2,094 billion rubles, including 1,288 billion for the central organization, 480 billion for the Siberian Department, 141 billion for the Ural Department, and 185 billion for the Far Eastern Department. On the whole this is twice more than what was actually received by the academy in 1995, and with regard for the suggested rate of inflation built into the calculations of the budget in 1996, it is 1.6 times more.

Of course as in all past years, the actual situation of our institutes will depend this year chiefly on the level of budget execution. But not only on this. Inspections of the institutes show that financial discipline leaves something to be desired in certain cases. This pertains to targeted use of budget resources, relations with commercial organizations we create, and other problems.

Now about scientific personnel. The total number of RAN scientific personnel is presently 57,463, having decreased about 25 percent compared to 1991. The average pay of workers of the RAN's central organization in 1995 was R341,000, which is twice lower than the country's average.

After several years of decreases in the total number of graduate students, last year this indicator increased for the first time by more than 380 persons to a figure of 4,376.

Compared to 1994, in 1995 the average number of RAN workers decreased 4.5 percent, which is somewhat less than in the preceding year.

Seventy-eight persons were accepted for doctorate work in the academy in the reporting year, which is 26 percent more than last year.

The number of dissertations defended in 1995 in the RAN's scientific institutions was 1,100 candidate degrees and 475 doctorate degrees, having stabilized at the 1994 level.

The decline in departure of scientific workers from academy institutions should be noted as a positive trend in 1995. In addition to this, the number of doctors of sciences grew 1 percent. This is evidence not only that the size of the academy staff is beginning to stabilize, but also that its qualitative composition is improving. Unfortunately the aging of scientific personnel of the Russian Academy of Sciences has been accelerating swiftly in recent years. The average age of colleagues is steadily increasing. The principle of continuity is starting to be violated in many scientific collectives owing to sharp reduction of the inflow of young personnel. The age gap between generations is growing, in the presence of a large deficit of the most active segment of scientists 30-40 years old. But on the whole, the quality of scientific personnel of the Russian Academy of Sciences is staying rather high. The RAN presidium adopted a number of measures to improve conditions in order to attract young people to academy institutes: scholarships paid directly to students and institute housing.

The Geography of Contacts

International scientific cooperation remained one of the priority directions of the academy's activity.

Last year agreements and protocols were renewed or new ones were signed with leading scientific institutions of Albania, Hungary, Vietnam, Israel, Tajikistan, Macedonia, Mongolia and France. Thus we have created a system of contractual relations with practically all of the world's largest scientific centers. I am referring to the academy's 87 agreements on cooperation, the RAN's participation in research under 40 intergovernmental agreements, and membership in 236 international organizations. Beside this, the RAN's institutes signed over 400 protocols on direct cooperation with foreign partners. A number of affiliates of our institutes were opened abroad, and joint international laboratories are being established.

Interaction with scientific institutions of CIS and Baltic countries occupied a large place in the academy's activity. In the last 2 years the RAN signed agreements on cooperation with all academies of sciences of the former USSR, with the exception of the Lithuanian Academy of Science, with which such an agreement is to be reached in 1996. Much was done in terms of implementing these agreements: exchange of scientists has been started, apprenticeship of graduate students

in RAN institutions was organized, and research on mutually agreed topics was initiated. The academy decided to provide its main scientific journals free of charge to the libraries of the academies of sciences of Commonwealth countries. Our Foreign Relations Administration has already begun implementing it.

Centers of Hope

Now regarding scientific instrument making. Targeted financing of this field doubled in 1995 compared to 1994, reaching R4 billion. Despite employment cuts the volume of products sold in 1995 was R10 billion, having increased by a factor of 2.1 compared to 1994. Profit amounting to R1 billion was received. The state scientific center "Scientific and Analytical Instrument Making" was formed out of facilities of the RAN Institute of Analytical Instrument Making. This measure should strengthen state support to the important direction of scientific instrument making, and raise it to a qualitatively new level.

Now about publishing activity. During 1995 the Russian Academy of Sciences continued to provide a subsidy to the Nauka Publishing House amounting to R11 billion, which is around twice more than in 1994. The publishing house's total output of books and journals in 1995 was R14 billion, having increased by a factor of 2.3 compared to the preceding year.

However, it was not possible to reach all of the planning indicators of 1995 completely. Compared to 1994, the output of books and journals decreased 30 percent as a result of 1.5-1.7-time increase in the cost of paper and printing services. This led to further decline in the level of information support to scientific research. The Nauka Publishing House completely stopped production of all 150 scientific publications as of 1 February 1996 in connection with termination of financing of the Russian Academy of Sciences.

In order to make things easier for publishing activity we recently reorganized the academy's Nauka Publishing House as the Izdatelstvo Nauka Academic Scientific Publishing, Polygraphic Production and Book Distribution Center of the Russian Academy of Sciences (the RAN Nauka Akademizdattsentr). RAN property carried on the balance sheets of all-academy, publishing, polygraphic and book trading enterprises was transferred to the balance sheet of the Akademizdattsentr with management rights. The new structure will have considerable financial independence.

Reorganization Continues

I would like to recall, among the most important events in the academy's scientific organizational activity, one of the most recent projects—analyzing the network of RAN scientific institutions.

In all of the last 4 years since the start of the market reforms, we strived to adapt the network of scientific institutions to the changing situation in Russian science and in the country, so as to preserve the nucleus of the academy's scientific potential, and ensure a high level of research in the face of shrinking financing. This work was essentially started in 1992, when the work of the departments started to be discussed in meetings of the academy presidium.

The research directions were defined more specifically, and the structure of many scientific institutions was changed. Unpromising research subjects were abandoned, and may laboratories and divisions were eliminated or reoriented. There were proposals to close or combine certain scientific institutions, or transfer them to other departments.

We do not think that our work is finished, or that the existing network is an optimum one. The academy's departments, both specialized and regional, are continuing this work in correspondence with the developmental trends of science, with the advent of new, promising scientific directions and with national priorities.

The presidium is striving to make its work as open as possible to the academic community and the public at large. We make statements in the press and at press conferences on all of the most important matters. As for how well we were able to do this, you'll have to judge for yourselves.

Russian Science Official on Academy's Problems

964D0797B Moscow POISK in Russian
No 14, 30 Mar-5 Apr 96 p 5

[Article by Igor Makarov, RAN chief scientific secretary; "Preserving Potential by Adapting"]

[FBIS Translated Text] Last year did not bring any significant improvements to the Russian Academy of Sciences, or to the country's entire scientific field.

In these difficult conditions, the presidium worked efficiently, in close coordination with the departments, on problems of scientific policy, financing, property ownership, and improvement of the academy's structure, and in organized activity aimed at implementing proposals offered at the annual general meeting in March of last year.

The draft Doctrine of Russian Scientific Development, approved in November 1995 by the government commission on science and technology policy, was actively discussed as part of the effort to carry out decisions of

the general meeting and the RF government decree "On State Support to Development of Science and Scientific and Technical Developments." Science and education are placed among the main priorities of state policy in the final report. Special emphasis was placed on the priority of fundamental science.

The work of listing the priority directions of fundamental research was completed, and the list was forwarded to the above-indicated government commission for consideration.

Basing ourselves on national priorities of science and technology policy and on the directions of fundamental research, in all of the last 4 years we tried to adapt the network of scientific institutions to the changing situation of Russian science and in the country with the goal of preserving a nucleus of scientific potential and ensuring a high level of research under the conditions of diminishing and sometimes hard-to-predict financing. Starting in 1992, the activity of specialized departments was discussed at meetings of the academy presidium. A large number of unpromising research projects were abandoned, 460 laboratories were eliminated and 300 new ones were established, and many divisions and sectors were reoriented as a result of this work.

Four scientific institutions were closed and six new ones were organized last year.

With publication of the government decree "On State Support to Development of Science and Scientific and Technical Developments" in April 1995, the academy made a special analysis of the network of scientific institutions. Eliminating four scientific institutions, dropping nine institutes from the academy, and transferring two of them from some departments to others were additionally proposed. In the Siberian Department, 30 institutes were brought together into 11 combined institutes, four institutes were transferred to the Academy of Sciences of the Republic of Sakha (Yakutia), and scientific research divisions under the presidiums of scientific centers were eliminated.

Seven of 14 assignments of the plan of measures of the general meeting were completely fulfilled, and five were partially completed. Two measures were not completed. They are development of a federal program to train young scientific personnel, and supplementing the RAN [Russian Academy of Sciences] charter in regard to the presidium's contractual relations with newly elected institute directors.

The presidium held 31 meetings in the reporting year. Twenty-two scientific communications from our scientists regarding important problems in the natural and humanitarian sciences were heard at these meetings, evoking considerable interest.

Close to 300 presidium resolutions were adopted, 580 orders were issued, and nine joint decisions of the academy and other ministries and departments were published.

On several occasions the presidium discussed a problem of the greatest importance to the Russian Academy of Sciences—property ownership. The main components of this problem are protection of intellectual property, preservation and use of real property, and land ownership.

As a result, remarks and proposals regarding legal standards pertaining to protection of intellectual property and development of patent and licensing affairs were submitted to state bodies. Included among them are a draft edict of the president of the Russian Federation "On Urgent Measures to Intensify Protection of Intellectual Property in the Russian Federation" and a draft interdepartmental program of measures to form a statewide system of protection and use of scientific and technological accomplishments.

Because of the absence of resources with which to pay duty, the process of patenting over 260 inventions was halted, and in addition, the institutes accumulated an enormous debt protecting objects of intellectual property abroad. The presidium managed to get resources allocated to the Russian Academy of Sciences to pay debts and to patent new, promising developments abroad. The directors of our institutes should display reasonable restraint when concluding patenting agreements, avoid going into debt if possible, and make a profit, as had been the case in the past.

A cost-accounting organization called Akademintorg was established several years ago for the advancement of the academy's scientific and technical developments abroad. However, it was unable to carry out this task in the reporting year, while concurrently duplicating the functions of Akademsnab [not further identified]. The activity of Akademintorg is an issue deserving special consideration at a meeting of the presidium.

Many unsolved problems remain in land use and real estate. Last year a register of the academy's property was compiled, supervision and accounting of changes in the composition of property are being organized, and the extent of land use in different territories was determined.

In defending property rights the academy took part in over 20 court proceedings in Moscow's arbitration court and in the Russian Federation's Supreme Arbitration Court. The academy prevailed in these proceedings.

However, the matter of returning the Porecheye Sanatorium to the academy has not yet been resolved.

Last year was not the most successful in work under the program "Science for Moscow." As a way to change the situation, proposals for improving the organizational mechanism of selecting projects and drawing up agreements were prepared. As a result Moscow's draft budget for 1996 foresaw allocation of 27 billion rubles [R] to our institutes as a separate item.

In order to increase extrabudgetary receipts the presidium of the Academy of Sciences should have returned last year together with the departments to its consideration of contractual business relations of RAN institutions with commercial organizations. Institute directors were instructed to analyze the effectiveness of this work on an annual basis with the goal of protecting the property, economic and legal interests of the collectives. However, most institutes never did submit any information on the work they did. It must be confessed that the task of creating an effective system of supervising interaction of our institutes with commercial organizations was not carried out in the reporting year, even though this is a very important problem associated with, among other things, observance of tax legislation.

Considering the anxiety scientists are feeling about the state of Russia's leading scientific schools, the academy prepared proposals on their targeted support jointly with the Russian Fundamental Research Fund. In September of last year the RF government adopted a decree allocating targeted subsidies to the country's leading scientific schools through the fund on a competitive basis, and determined the procedure for carrying out the program of targeted support to the leading scientific schools. An additional R34 billion were allocated to the fund last year for these purposes. Because of certain problems in the country, the money hasn't yet reached the scientists in its full amount, but it is hoped that it will be forthcoming in the very near future.

There is hope that edicts of the RF president granting draft deferments to certain categories of citizens, establishing RF state prizes for young scientists, and establishing additional measures of social protection for graduate students in the Russian Federation's educational institutions will significantly help to fill the scientific institutions with talented young specialists.

Coordination of the Russian Academy of Sciences with the system of higher education continued to develop in the aspect of preparing young specialists for scientific institutions of the RAN and to conduct scientific research. The Higher Chemical College under the Russian University of Chemical Technology imeni D.I. Mendeleyev, the Higher Physics College under the Moscow Institute of Physics and Engineering, the Higher College of Material Sciences under Moscow State University and others, created with the participation of institutes of the Academy of Sciences, are currently functioning.

The RAN presidium executed all of its organizational and financial obligations regarding payment of state scientific scholarships to outstanding and talented young scientists. In 1995 the commission for state scientific scholarships under the RAN presidium held an additional contest—a third, and a fourth in February of this year.

Many major scientific results were achieved in 1995 in work with unique facilities and complexes possessed by RAN institutions. The presidium took the necessary steps to keep them serviceable. In particular, proposals submitted to the Russian Federation Ministry of Science and Technology Policy and the Ministry of Economics on developing the scientific and technical potential of the Russian Academy of Sciences in 1996-2005 turned special attention to maintaining, building and modernizing the unique facilities and complexes.

In the area of international scientific cooperation, the presidium maintained its course toward comprehensive development of creative relations with foreign partners, and chiefly with scientists of CIS countries.

Housing continues to be one of the most urgent problems of the social sphere for many academy employees. According to data of the Affairs Administration, in 1995 the Academy of Sciences received and distributed over 7,000 square meters of housing space, which improved the housing conditions of 78 families; around 1,500 families are waiting their turn.

No additional resources to finance boarding houses were found last year. The Affairs Administration needs to be more persistent in its search for a solution to this important social problem.

Repairs on polyclinics were finished over the course of the last 1.5-2 years, and they are being refurnished with modern diagnostic equipment. A 270-bed hospital was placed in service in the city of Troitsk. The hospital complex in Vladivostok was repaired, and a hospital building was erected at the Sanatorium imeni M. Gorkiy in the city of Kislovodsk.

Experience shows that developing forms of the academy's effective interaction with legislative and executive bodies of government remains an extremely urgent task. Bodies of state government and administration sent around 1,700 documents containing various assignments to the Academy of Sciences. Sixty-four expert opinions

on draft federal laws and 43 opinions on draft RF government decrees were prepared in the Academy of Sciences in response to requests and applications from the houses of the Federal Assembly and their committees, and assignments of the RF government and the administration of the RF president. The academy leadership established and maintained contacts with the supreme leadership and with committees and commissions of the Federal Assembly.

Russian Technical Sciences Academy Plan Revived

964D0757A Moscow SEGODNYA in Russian
28 Mar 96 p 5

[Article by Vladimir Gubarev: "The Academy of War: Who Is Attempting to Create It, and Why?"]

[FBIS Translated Text] A rifle hanging on a wall will certainly be fired—or so one of our famous writers assures us. But what if this is not a rifle, but an armada of missiles and tanks, nuclear devices, and salvo fire systems? Does this warning still fit?

I'm forced to answer "Yes," unfortunately.

War is advancing, coming closer, capturing new "beachheads." What is most terrifying is that this is happening among the intelligentsia, among scientists and specialists who in the past, out of shame, covered themselves with the fig leaf of secrecy but who now demand attention, bragging of their capabilities for destroying everything living on Earth.

It seems to me that this reflection of Chechnya is no longer in the souls of the people, but has spread to their clouded reason.

Foremost in my mind is the attempt to create an "Academy of War" undertaken by a group of scientists associated with the military-industrial complex. It is true that at first glance this academy bears an extremely "peaceful" name: "Russian Academy of Technical Sciences," but everything fits into the proper place in a letter addressed to RF President B. N. Yeltsin. It reads: "An enormous scientific potential comparable only to the scientific potential of the U.S. and representing 75 percent of Russia's overall potential has been accumulated in the defense complex. Over 2,500 doctors of sciences and 20,000 candidates are toiling in more than 700 scientific research organizations of defense sectors of industry.... In order to raise the scientific and technical level of research on the most important problems, both in defense technology and in the science-intensive directions of creating modern civilian products and dual-use technologies (especially in this time of conversion of military production), in order to unite the creative potential of our schools, scientists and specialists, and in order to coordinate this research, it would be suitable to establish the Russian Academy of Technical Sciences (RATN) as Russia's supreme state scientific institution in applied technical sciences of defense sectors of industry."

The letter to the Russian president was signed not only by ministers heading the defense ministries and departments but also by a group of academicians—leaders of the largest defense enterprises and scientific centers. Their names are so weighty and important that one gets the urge to pick up a pen and immediately sign the edict, a draft of which is appended to the letter.

What is happening in the "kingdom of science"?

There are large numbers of different kinds of "academies" today. There are academies of astronomics, culinary arts, engineering, information science, astrology, magic and wizardry, and so forth—so many that no one is even able to list them all! And I have been invited on several occasions to various "academies," where I was promised the "academician" title, and more rarely—oh, what an insult!—just "corresponding member." People don't always consider what it means to be such an "academician." It's nothing like being an academician elected to the Russian Academy of Sciences, admission to which is not just granted to anyone. It was the dissatisfied and insulted that started a campaign in the late 1980s and early 1990s to close down the Big Academy, trying to prove that it was "conservative" and "antidemocratic." It's a good thing that the Academy of Sciences was established 250 years ago, since otherwise it truly may have been closed down in the heat of democratic transformations.

As long as there are so many academies of different kinds, and there are some among them that have withstood the test of time—like the medical and pedagogical academies—why should we oppose the appearance of a new one?

A draft presidential edict is appended dutifully to the letter to the president. It contains 12 items, each of which promises literally a "revolutionary transformation" in modern science. It also contains a decision by which defense departments and ministries will **themselves** appoint the first 200 academicians and corresponding members from "among outstanding scientists and organizers of science." Now here's a real carte blanche for bureaucrats! Other items of the draft naturally foresee assignment of property to the RATN, "financing of projects with special attention to forming state orders," an "oversight council" under the government (to keep track of finances!), and of course, exemption "from taxes, fees, and duties, including on foreign exchange received from foreign economic activity," and

many, many other things. Still, the main thing is this: "Financing of the Russian Academy of Technical Sciences shall be foreseen as a separate item when drafting the federal budget of the Russian Federation for 1996 and subsequent years...."

Now this makes everything absolutely clear: Even with the state so short of money, what bureaucrat is going to object to giving resources to an "Academy of War"?! And all the more so if he is made an "academician" in it!

The sole consolation is this: the Russian bureaucracy is flourishing, and the letter to the president and the accompanying draft edict are making their endless journey from one desk to another. And sometimes when they suddenly emerge in the light of day, the idea of establishing an "Academy of Sciences" is brought up for discussion either in some ministry or in the Russian Academy, depending on where the documents reappear. Once again RAN [Russian Academy of Sciences] President Yu. S. Osipov is compelled to open a meeting of the presidium with an apology: "The Academy of Sciences received the following instructions from the Russian Government: Discuss the matter of establishing the Russian Academy of Technical Sciences."

A murmur spreads among the academicians: We've already discussed this.

"It is of course true that we have discussed this matter three times at meetings of the presidium, though in somewhat different context," Yuriy Osipov instantly reacts: "I dug up the stenographer's reports on the discussion, and studied them carefully. Sometime ago we asked Academician Velikhov to head a working group on this matter, and naturally we will now ask Yevgeniy Pavlovich to report on the current situation...."

I don't think I'd be revealing any great secret if I said that Academician Ye. P. Velikhov was and remains the initiator of establishment of the new "Academy of War." To be honest I wasn't very sure why this was so important to the vice president of the Russian Academy of Sciences, which is why I awaited his briefing with keen interest.

Ye. Velikhov: "First, there is the argument of the institutes. As a representative of the Kurchatovskiy Institute I must say that we are currently in a vacuum. Applied institutes currently lack the appropriate interaction with the corresponding bodies of government. We are resolving our problems of existence and survival, but first of all with great difficulty and ineffectively, and, secondly, without a united front. We simultaneously came to realize that both applied science and high technology cannot be simply thrown to the whims of the marketplace. The market is a very important tool, but it is a tool that can destroy as well as create."

Academician N. Basov: "But how much will the new academy cost? The RAN is being shorted today by a minimum of 10 times! If we want to do something, we will first have to put the Russian Academy of Sciences in order, and then talk about the other. We need to increase appropriations to our academy by 10-20 times, after which things will be much better for science. When one academy is falling apart, why establish another?!"

Academician A. Prokhorov: "We are talking about preserving the production base. That means someone created it sometime in the past. There was no Academy of Technical Sciences, but the base was established. Now people are saying that the base is disintegrating, and we have to establish a new academy to save it. Wouldn't it make sense to explore the past and see how the production base was created, and how it was supported?"

Academician N. Shilo: "I need to clear up something for myself. Given the situation that has established itself in the country, and the structure that has evolved in science, whom are we supposed to be defending ourselves against by establishing such an academy?"

Academician B. Bunkin: "As I see it, organizing the Academy of Technical Sciences will allow us to develop basic technologies applicable to different sectors of science and engineering. This is why I support establishment of this academy."

RAN Corresponding Member V. Pashin: "I would like to speak simply as the director of the Krylov Institute, which has in fact been cast to the whims of destiny together with most of the institutes—the Central Aerohydrodynamic Institute, the Central Institute of Aviation Engine Building, the All-Russian Aviation Materials Institute, Prometey. Consequently, we certainly need an organization which would not only keep us in line but could lobby the government as well—we need an organization such as the Russian Academy of Technical Sciences!"

It seems to me that this scientist offers an extremely clear statement of what our designers and directors of the former "closed" institutes expect from the "Academy of War."

Academician A. Koroteyev: "I am the director of the Scientific Research Institute of Thermal Processes, which is part of the Russian Space Agency. This institute has a history of more than 60 years, and it is credited with definite accomplishments. At different times, 29 full members and corresponding members of the RAN worked at the institute. Our response to

the idea of establishing the new academy is one of great attention and great caution. Still, after we weighed all of the pros and cons, we decided to support its organization. There are three reasons for doing so.

"The first: There is the need for sensible coordination of applied science. It is well known that this was done through the efforts of sector institutes in the USSR. They differed: some were stronger, some weaker. But now the overwhelming majority of them are in confusion. The problem lies not only in finances but also in the fact that most of the institutes have no assignments. The Russian Academy of Sciences is doing practically nothing to coordinate applied science. A body with recognized authority could do this.

"Second: I feel that establishment of the new academy could reduce the danger of devaluation of the authority of our present Russian Academy of Sciences. An enormous number of organizations that have added the word 'academy' to their names have been established in the country. This is not as harmless as might seem at first glance. Let me give you an example. Once the State Duma was discussing the space issue. The meeting chairman said, with no embarrassment whatsoever, that there were 70 academicians in the auditorium. In reality there were two actual members of the RAN in the auditorium, while all the rest had assumed this title on the basis of the fact that they were members of one of the countless numbers of different 'academies.'

"The third consideration: The new academy could become a scientific body providing coordination to interdisciplinary research on new technologies—that is, it could do the work that had been done before by scientific councils in the military-industrial complex."

Academician V. Kirillin: "It seems to me that our situation is very bad today. This is a result of two factors. First, the low financing. Second, the unusually large number of new academies: We don't even know how many of them there are, or what each of them is supposed to be doing. Before, the academy used to have a Department of Technical Sciences. It was abolished at M. V. Keldysh's initiative. The idea was this: Every sector of technology must be closer to its supporting science. It seemed as if such integration would be highly successful. But now the situation is different, and we have to think about how we are to live in the future."

Representatives of the defense complex naturally set the tone at the meeting of the RAN presidium. It is clear just from the passages I cited here that the situation in it is catastrophic, and defense specialists are trying to find the straw that will save their institutes and centers.

But might the solution be something totally different?

All right, let's admit that the Soviet Union wasn't a penny-pincher when it came to developing the directions we call "military." Moreover the scale of armaments was so great that once it becomes known, it cannot but astound the imagination. But not in the usual sense: the feeling is not one of admiration of what has been done, but of terror of what it might lead to!

And the most terrifying thing is this: weapons were created in the USSR to repel attacks from without, and for this sake the Soviet people made the highest sacrifices—the specter of the horrible war that we so recently endured was hovering our generation, after all. But what about today? Why create ultramodern and even-more brutal forms of armaments? Unfortunately the military strategy that was either approved or just sketched out—I'm not sure—doesn't say anything about the main goal, and doesn't answer the main question of defense: Against whom, in the name of what, and who is the potential adversary? If he is across the ocean, then we need powerful strategic forces and attack submarines. But if we are separated only by land, why have nuclear submarines?

There are probably grounds for saying that the arms trade occupies second place in the world market after oil and gas. Modern passenger airplanes, the U.S.'s motion pictures, computers, medical laser technology and many other things also sell reasonably well in that same market. Moreover countries like Japan do not offer either aircraft carriers or salvo fire systems on the world market, but their standard of living is much higher than ours, even though we were among the leaders of the arms trade in the not-too-distant past. No, this argument isn't very convincing, either, when the discussion turns to establishing an "Academy of War" in Russia.

I'm not looking at just the political aspects of this decision: we in Russia have long been accustomed to the fact that the positions and principles of the state's leaders change quickly. And the possibility is not excluded that this very evening one of the "biggest chiefs" will announce that Russia's strength lies in possessing the most sophisticated types of weapons and the ability to transform the globe into a desert. Anything is possible in our times. However, creation of an "Academy of War" would essentially mean returning to the origins of the Cold War. And if this isn't understood by all scientists, then it's a pity, because when we create weapons, we must have a clear idea of where and when they might be used.

But let's be honest: not all scientists support the idea of the new academy. Moreover it is a majority, after all, that opposes this initiative. At that same meeting of the RAN presidium, Yuriy Sergeyevich Osipov read

two messages into the minutes—one from the Siberian and another from the Ural department of the RAN. One passage in particular read as follows: "The organization of research in defense sectors of industry cannot be set up completely under the same principles on which fundamental science functions. Rather than separating scientists among different academies, we must seek ways to strengthen interaction of scientific research organizations of the defense complex with institutes of the Russian Academy of Sciences. It would be suitable to provide state support to this interaction by expanding state programs under which a way to broaden the subject matter of civilian research could be found."

It seems to me that the message from the Urals very clearly determines the role of the defense complex—it must serve science and the motherland, and not vice versa.

There are many academicians in the Russian Academy of Sciences, but it is not their number that defines the greatness of our science: only a few are true sages. One of them is Nikolay Gennadiyevich Basov. He has all of the lofty titles and awards, and world recognition to boot, but what is still most important in his character is his ability to rise above the ordinary.

In this discussion Nikolay Gennadiyevich not only asked questions of the speaker and persons entering into the discussion, but he also stated his own point of view in the end. As always, it was unusual, but very understandable and obvious.

"What's wrong with this discussion?" Academician Basov began. "We are looking at just a part of the problem: of science, in a time when its main organism—the Russian Academy of Sciences—is struggling terribly. It can't go on living like this any longer. We are losing the possibility for understanding what is happening today in the world. This is true of biology, electronics, and the electronic base, which is no longer usable in our country. We need to think first of all about biological science and medicine. We have lowered the level of our medical services, there are many synthesized substances that we can't make, and things are very bad with drugs. And with medical instruments as well. The Americans manufacture laser measuring instruments for $40 billion. They are used in new surgical methods, in examinations, and so on. I know that military engineering is very important. I myself worked in that field a long time. But limiting ourselves to just this would be shameful for the country! And it is something we mustn't do."

We commonly refer to our 20th century in the most diverse ways—for example the century of electronics and the atom, of space and biology, the century of the greatest accomplishments of human thought. All of this is of course true. But we are obliged to remember that the 20th century is also a century of Perpetual War, strung together out of large and small wars, conflicts, operations, national differences and criminal "settling of scores." It is hard to remember a more brutal and merciless century in the history of human civilization than the one in which we are living and which is coming to an end. Are we and our children really supposed to enter the 21st century with this kind of baggage?

I personally don't want to.

Russian S&T Minister Downplays Brain Drain

964D0756A Moscow KULTURA in Russian 30 Mar 96 p 3

[Article by Russian Federation Minister of Science and Technology Policy Boris Saltykov: "Comrade Scientists and Lecturers With Candidate Degrees"]

[FBIS Translated Text] When you talk with old people who represent the pride and glory of Soviet science, you often hear this question: Why does the state treat its golden reserves so badly? One prominent scientist who spent his whole life creating a laser for "Star Wars" now finds himself out of a job, grief-stricken and angry. The fact is that what the society needs from science has changed under the new conditions. This, alas, is an unavoidable consequence of the decision adopted in 1991 to begin radical reforms in the economy.

In the first years of perestroyka, no matter how much discussion there was of the necessity for reforms, everything kept on in the same old way, including growth of military potential. Then suddenly there came a time when the economy could no longer endure this, and the country needed to be rescued. Part of the plan for doing so included freeing prices, demilitarizing, and opening up the borders. As a consequence,in 1992 defense orders shrank immediately by several orders of magnitude; plants stopped working, which in turn dealt a blow to science: it's no secret that our scientific potential was oriented to a great degree on the needs of defense.

The scientific and technical intelligentsia, which brought Gorbachev and then Yeltsin to the helm, and which hoped for rapid change in social conditions and onset of freedom, did not of course expect that reforms would improve its position on the spot. But it also did not suppose that they would worsen things so much.

We changed the model of society, disavowed confrontation with the outside world, and opened up the borders. Science is a part of the society, it cannot but change, and it must assume part of the burden typical of any time of restructuring, and particularly of such a fundamental sort as we are now experiencing. As it turns out, this kind

of society needs science of other volumes and types. In the era of the Iron Curtain our scientists developed all scientific directions concurrently under the concept of a "continuous front," because the rest of the world was developing them. Now that science has become open, actively communicating with science in other countries, it is more sensible to finance just the most necessary directions of the highest priority.

In the past, our science was a self-sufficient administrative system whose existence depended on the distribution of resources. What gnashing of teeth there was when a person wanted money for an interesting research topic, but couldn't get it because he was at odds with his superiors! The first thing we did was to create a system of independent sources of financing—extradepartmental funds. The State Fundamental Research Fund distributes money regardless of where you work. A project of one scientist undergoes expert examination by other scientists (and not administrators!), and if they think it's a good one, they appropriate the money.

Applied or, as it is known, sector science, has always been under ministerial jurisdiction in our country. Scientific research institutes received orders from their ministries. Nowhere in the world was there such an enormous number of state institutes, and of such size, as in our country. But the union ministries collapsed, and sector science found itself lacking management and orders. We tried to save some of the elite institutes: we selected 60 of the best, like the Central Institute of Aerohydrodynamics, the Kurchatovskiy Atomic Energy Institute, the Obninsk FEI and others, and created a system of state scientific centers. We financed them on the basis of individual programs. In short, we are trying to transform an unresponsive system that is absolutely incapable of adapting to the market. Tens of thousands of small laboratories, independent enterprises and joint-stock companies have already budded off from the institutes, and are living on their own.

But what about the scientists? The luckiest either continued their work in their specialties in Russia (the directors of some institutes are introducing a contract system by whatever means they can, and using creative means to provide a worthy standard of living to their best colleagues), or went abroad, where they found better conditions.

How much have we lost as a result of the brain drain? Some newspapers cite fantastic figures—180,000-200,000 scientists.... This is but an indication of a complete lack of understanding as to what a scientist is. In the strict sense, a scientific worker is one who produces new knowledge and, consequently, regularly gets his articles printed in prestigious journals.

And so, when Soros organized his fund, he decided to give money to all who had at least three articles published in prestigious scientific journals in the past 3 years. Twenty-six thousand persons met this criterion. If we assume that persons of high distinction did not submit applications (for them, $500 was not all that big an amount in 1992), we could increase this quantity of people. Consequently there were approximately 50,000 active scientists in 1992. And when I hear that 200,000 scientists supposedly left the country, I am forced to ask: in that case, who's left? The losses are of course great, many thousands left. But the calculations are highly approximate, because statistics of the Ministry of Internal Affairs account only for the education and the field of endeavor of the departing individual, and they do not tell us if he is a scientist or an engineer.

Emigration has now slowed down. "Worker-bee" emigrants who leave forever no longer play a large role, but so-called contract emigration, under which a person obtains employment for a year or two in a foreign scientific center or university, has become a new, widespread and destructive phenomenon. If such a person is a laboratory director, a project supervisor, or the leader of a scientific school, a year's absence could cause the collective, the project, or the direction of study to disintegrate. The hope of course remains that the person will return, and everything will someday return to the way it was. But this is consolation only in the strategic, long-term aspect. At the tactical level it is a major loss, and a serious blow to the country.

Fundamental science is in the gravest position in this sense in our country. The better the institute, the larger the losses. Thirty percent of the personnel of the Institute of Theoretical Physics imeni Landau are working here, 30 percent are in the West, and 30 percent are constantly shuttling back and forth.

I can't help complaining: the amount of money provided to science is stupidly small! The most shocking thing of recent months is that budget indicators are absolutely not being met. A government decree promised 3 percent of the budget for science. Its final version promised 2.77 percent. But in January science received approximately an eighth of what was written into the budget, and about half in February. And this is despite the fact that December was a disaster—only a fourth of what was authorized was received.

And as long as budget appropriations are clearly insufficient, as long as industry remains depressed, and as long as the demand for innovations remains absent, scientists whose services are not required will continue to leave. We are trying to fight this. Last year for example we created a fund to support the leading scientific

schools. Certain amounts were distributed to the leaders of scientific schools on the condition that they would give it to their students, so as to somehow support the schools. But these are miserly amounts, and insufficient measures. Fundamental changes are possible only after the economic situation changes. It is then that the brain drain will automatically cease.

According to the statistics of pre-perestroyka years there were around a million scientific workers in Russia. Of course these were not scientific workers in the strict sense of the term, but only persons employed in science. The hundred-ruble-a-month junior scientific associate was the target of all satirists in the 1970s. Entire institutes (NIIChego [Scientific Research Institute of Nothing] as the Strugatskiy brothers put it) did basically nothing worthwhile. Without question, we did have an overabundance of persons employed in this way. We succeeded not with ability, and not with quality, but with quantity. While in the West one good instrument and an automated system for running an experiment would be used in a particular situation, we would use five technicians, five laboratory assistants, and another five or six scientific associates doing the work of laboratory assistants. Many in this army of people with generally weak scientific credentials were forced in a time of crisis to seek new points of application of their efforts.

The most dynamic, independent and foresighted found new niches for themselves before the reforms, or in their course: they organized firms, or left for jobs in financial organizations or in state bodies of government. In the U.S. for example, people leaving science for business or for industry, where they prove themselves to be innovators, are considered to be a normal phenomenon. In our country, many innovative firms have now risen to a firm stance, and are beginning to live reasonably well. Innovative entrepreneurs who are able to derive money from scientific and technological developments by helping to introduce them are moving scientific and technical progress forward.

Movement of manpower into new sectors, which is a natural attribute of an economy, is rather stressful to many people working in science. Among today's unlucky scientists there are good people who doubtlessly do well in their fields but find their services unnecessary to science today. Fate has been especially hard on them. And what, we ask, are they to do now? I see no simple solution to such a case.

This reminds me of a laboratory in a certain idle institute employing 30 associates. Around five to seven of them are totally worthless. Three or four talented individuals could easily have left. They have been offered good money in new jobs. But their response is this: How could we possibly leave? Our families have now been playing together for 30 years! But in that case something has to be done where they are—to make the laboratory and the personnel survive. After all, all of the ties of friendship that they don't want to break and the feeling of belonging to a team are also capital, which could be relied on to start a new business.

But here's another example. The Novosibirsk Nuclear Research Institute, which studies the fundamental properties of matter, is concurrently producing small, desk-sized accelerators enjoying a demand abroad, and making a living off of this. The Institute of Catalysis imeni Boreskov sells licenses and organizes production of catalysts. Some of its associates earn as much as 3 million rubles, as compared to an average wage of 500,000. They are envied by all, and for good reason.

When the economic mechanism of a planned socialist system was working, it was disadvantageous to work well, and one could work poorly with impunity. Now the barriers have been lifted, the stimuli for labor are working, and a savvy scientist can find money for research. And now that conditions favoring initiative have appeared, the end result depends on whether or not this opportunity is taken. **My hopes rest on resourceful people.**

From the Editor

So the minister is counting on resourceful people, resourceful people are counting on themselves and Western grants, but who is Russian science, which is disintegrating before our eyes, to rest its hopes on? Strange as it may seem, only on itself. This is not the first time Russia's scientific and technical intelligentsia found itself in a situation like today's. After the revolution and civil war, university departments were emptied and research laboratories were closed. But before the roar of the socialist cataclysms died down, the lecture halls began to be filled with young people possessing curiosity that could not be satisfied by anything other than scientific activity, and who found research to be the only avenue for self-expression. Science will not perish as long as the people survive.

Yes, today's social disorder created a deep fracture through the fate of the present generation of scientists. But a true scientist is distinguished from most people surrounding him by sober thinking and keen awareness. He should understand better than anyone else that they have to see to their own destiny. No matter what politicians win the elections, and no matter what promises these politicians make, none of them are going to make resurrection of science their highest priority, and, moreover, none of them will return Russian science

to its blessed and stagnant state of the 1970s-1980s, when there were as many scientific research institutes in the country as there were rayon committees of the CPSU. No matter how you look at it, these are different times, and much water has passed under the bridge. The scientific community must understand that working like it did yesterday, with full state support, with no thought as to whether research on a particular topic is something the society needs, is now simply impossible. You can't get over the transitional period in a single leap. It is important for the participants of this process to clearly understand what it was that we rejected, and what it is toward which we are moving, toward which we have mobilized the intelligence for which scientists have always been respected, and it is important for them to try to find themselves in the new conditions.

The fate of Russian science is a hard thing to discuss. Our hope is that readers will join the discussion of the problems raised here, and express their opinions on them.

Russian S&T Pubs Delayed by Budget Problems

964D0756B Moscow KULTURA in Russian
30 Mar 96 p 3

[Interview with Prof Vladimir Ivanovich Vasilyev, Nauka Publishing House director, by correspondent Petr Deynichenko; place and date of interview not given: "Only Memoirs Are Profitable"]

[FBIS Translated Text] "The Nauka Publishing House has closed": This was the message with which certain newspapers and radio stations stunned intellectuals. What was this, news of a real disaster, or a false alarm? Our correspondent met with the director of the Nauka Publishing House, Professor Vladimir Vasilyev.

[Deynichenko] Vladimir Ivanovich, has Russia's leading scientific publishing house really departed from this world?

[Vasilyev] The radio report regarding the publishing house's closure, which was subsequently picked up by the newspapers, is a fraud. I never gave any sort of interview. They recorded bits and pieces of things I said somewhere, possibly at a meeting, and broadcast it in interview form. Nauka is actually still working: all six of its book publishers, its printing enterprises and the bookselling system. All I talked about was a temporary halt in the work of a few Moscow academic journals. This is because the Russian Academy of Sciences didn't receive any budget financing at all in December, and only a third of what was needed in January. Prior to this we were able to make ends meet by attracting borrowed resources, but this time, because by early February we had no guarantee that the state would return our money, we didn't feel it possible to take such a risk.

[Deynichenko] What do you mean by "publication temporarily halted"? For very long? How many journals will not be published?

[Vasilyev] One hundred thirty-four scientific journals of the Russian Academy of Sciences are published in Moscow. Around 60 percent of them had no money for wages in February. I can't imagine that a way to rectify the situation will not be found. Moreover it should be found rather quickly.

[Deynichenko] Why is it that scientific journals are in such a serious situation, while others are not?

[Vasilyev] We can't sell journals at their real cost. The annual subscription to many of them is hundreds of dollars abroad. The Academy of Sciences deliberately supports low prices so that scientists and libraries of the institutes and VUZes [higher educational institutions] could subscribe to them. Because science simply loses meaning when the results of scientific research are not published and information is not communicated to specialists. The expenses of publishing journals are a protected item of the academy's budget. But if the academy has no money, we can do nothing but stop publication of the journals.

[Deynichenko] But can't you finance publication of journals with income from other work?

[Vasilyev] You're not going to support 1,400 issues of money-losing journals annually with the book program. It takes an enormous amount of working capital to publish just a dozen profitable books a year. Moreover you first have to find profitable things to publish, and then sell them. Meaning that a publishing program that could recoup the losses of our scientific journals does not exist. The best that we can do is economize. We are absorbing some of the general business expenses ourselves, making plainer book covers, using cheaper grades of paper, and moving the work of typesetting the journals from the printing offices to our own publishing houses and institutes. The Academy of Sciences will get financing, and readers won't notice the difference. But if it doesn't.... In any case the academy will search for ways to keep publishing the journals.

[Deynichenko] What is happening with books? It's not all that easy to buy scientific literature in Moscow anymore.

[Vasilyev] The book publishing volume has dropped. The numbers of copies printed have dropped dramatically, and it's become hard to put orders together because the state-run book distribution system has col-

lapsed. We now distribute our catalogues through our own network—through stores of the firm Akademkniga. But it reaches a rather narrow range of customers. We were severely undercut when our mail order system went down, but what can we do when mailing costs are more than the price of the books?

[Deynichenko] Despite all of this, are you still afloat compared to other publishing houses?

[Vasilyev] It's rather difficult to compare. The scale of our operation is comparable to all other scientific publishing houses taken together. This year we will print more than 600-1,000 books, while state scientific publishing houses will each put out a few dozen. When it comes to the economic side of things, as with other scientific publishing houses we are extremely limited in our resources, because 99 percent of today's scientific publications are major money-losers.

[Deynichenko] Who finances publication of scientific literature?

[Vasilyev] Scientific institutes, state and public funds, embassies, several banks with which we cooperate and from which we receive soft loans, sponsors, and authors. That is, we use all legal means and resources. There is a federal program, but its impact is negligible.

[Deynichenko] Could publication of scientific books be profitable?

[Vasilyev] Some books could of course be of interest to the general public, and provide a small profit, but they are but few. Scientific monographs and works are money-losers, because very few copies are printed, not more than a thousand. A profit could be made from publications like, for example, the book "Mir russkoy usadby" [The World of the Russian Farmstead] released last year, or Yaroslav Golovanov's recent major work "Korolev: mify i fakty" [Korolev: Myths and Facts]. In other words a profit can be made only from books that can be published in over 10,000 copies. For example, certain literary memoirs, philosophical memoirs, historical memoirs, and certain academic complete collected works.

[Deynichenko] Popular scientific literature enjoyed a huge demand around 15-20 years ago. It has now disappeared almost completely. Are readers really no longer interested?

[Vasilyev] It's become a money loser as well. Numbers of copies have dropped by a factor of 100-200. I think that the problem here lies not in a change in the interests of the reading public but in low purchasing power. The same thing also happened with popular scientific journals. As an example KHIMIYA I ZHIZN used to be published in over 300,000 copies, and brought in enormous profits. But now it is printed in less than 7,000 copies. Luckily the Academy of Sciences continues to support popular journals—in the interests of science and the society's spiritual development. The academy never put priority on commercial goals.

Oftentimes many of our books become best-sellers simply because we can't print enough of them. Booksellers can't pay in advance and hold them in reserve. We print exactly enough to fill the orders we get. But the orders we get are miserly because the centralized system of placing orders collapsed together with the centralized bookselling system. Moreover, for practical purposes we have lost the market consisting of 14 republics of the former USSR.

[Deynichenko] Why can't you reprint books for which there is a demand from time to time?

[Vasilyev] Reprinting would still be a big money loser. If only we could sell books at prices covering the costs. But now the situation is a paradox—the more we print, the greater the loss.

[Deynichenko] Might this trend change in the foreseeable future?

[Vasilyev] Only if the overall economic situation in the country changes. To get a profit, we have to sell books at world prices. But customers also need to be receiving adequate income. Only then will we be able to talk about normal trade. Everything else will fall into place.

[Deynichenko] Several new small publishing houses have begun releasing scientific literature in recent years. Will they be able to offer competition to you?

[Vasilyev] I'm afraid that these are mostly publishing houses for which the image of the Russian Academy of Sciences is important for one reason or another. They are prepared to publish a few money-losing books, and sometimes even give them out free of charge, but earn money elsewhere to compensate. The unfortunate thing is that they do not always publish scientific literature that is high quality from the standpoint of publishing excellence and from the standpoint of the product's appearance. Oftentimes academy publications are simply stolen. In the meantime small publishing houses that take their work seriously and concentrate only on scientific literature find themselves in a difficult situation. Many of them unfortunately close.

[Deynichenko] Is Nauka able to support all directions of literature publishing today?

[Vasilyev] Yes. All book series continue to be published: "The Literary Legacy," "Memoirs of Philosoph-

ical Thought" and others, and even narrowly specialized ones like "Mammals of Russia and Contiguous Regions."

[Deynichenko] What will appear on store shelves in the immediate future?

[Vasilyev] Perhaps the main thing will be academic collections of classical Russian works. We have already released the first two volumes of the academic complete collected works of S. Yesenin jointly with the Golos Publishing House, and the remaining five volumes will come out this year. Blok's complete collected works will begin coming out in 20 volumes in the first quarter, and printing of the academic collected works of Goncharov will start in the immediate future. Publication of books honoring Pushkin's 200th anniversary will continue in St. Petersburg. In the next few months we plan to publish Gorkiy's correspondence—this will be the second series of his collected works.

Russia: Yeltsin Edict on Basic Science

964D0880A Moscow ROSSIYSKAYA GAZETA in Russian 24 Apr 96 p 5

[Text of Russian Federation President's "Edict On Measures to Develop Basic Science in the Russian Federation and the Status of the Russian Academy of Sciences" signed in Moscow 15 April]

[FBIS Translated Text] In order to provide for the appropriate legal guarantees and material conditions to develop basic science in the Russian Federation, as well as to enhance the role and status of the Russian Academy of Sciences, **I decree that:**

1. The Russian Academy of Sciences is to be an all-Russian, self-governing, noncommercial scientific organization;

—the Russian Academy of Sciences is to be financed by funds from the federal budget and other sources stipulated by laws of the Russian Federation; and

—the Russian Academy of Sciences is to conduct basic and applied research on the most important problems in different scientific fields and take part in coordinating the basic research conducted with federal budget funds.

2. The Russian Academy of Sciences and the enterprises, institutions, and organizations subordinate to it are to be exempted from the obligatory sale of foreign exchange earnings, under the condition that the currency resources made available are used to develop scientific activity and train scientific personnel.

3. The Russian Federation Government:

a) is to approve within a period of 2 months the list of subordinate enterprises, institutions, and organizations submitted by the Russian Academy of Sciences;

b) is to approve within a period of 3 months the list of facilities in federal ownership assigned to the Russian Academy of Sciences with the rights of operational management and economic administration, to be submitted by the Russian Academy of Sciences in coordination with the Russian Federation State Committee on the Administration of State Property;

c) is to develop and submit to the State Duma of the Federal Assembly the draft of a federal law providing for preferential taxation of the Russian Academy of Sciences and the enterprises, institutions, and organizations subordinate to it; and

d) is to provide for the following in preparing drafts of the federal budget, beginning in 1997:

—allocation of funds in a separate paragraph for the Russian Academy of Sciences, including its regional branches, for target-oriented financing of basic research, as well as to build facilities for scientific-production purposes and the social sphere of the Russian Academy of Sciences, in an amount no less than 1.5 times more than the level of the corresponding expenditures in the federal budget for 1996, taking annual inflation into account; and

—allocation of an additional 50 billion rubles annually for a 5-year period, taking inflation into account, to build housing for young scientists.

[Signed] President of the Russian Federation B. Yeltsin

Moscow, the Kremlin
15 April 1996
No. 558

Russia: Open Sky Policy Debated

964D0614A Moscow SOVETSKAYA ROSSIYA in Russian 1 Feb 96 p 2

[Article by Galina Sedykh: "All That Remains Is to Sell the Sky"]

[FBIS Translated Text] The mass media, particularly the newspapers IZVESTIYA, MOSKOVSKIY KOMSOMOLETS and MOSKOVSKIYE NOVOSTI and channel NTV, have recently been exaggerating with enviable persistence on the subject of opening Russia's airspace to international flights. This will supposedly set up Russia's skies and create "favorable conditions for conversion of defense industry enterprises working in satellite technology, and change the world's air transportation infrastructure." In connection with this, certain "concerned citizens" wanting to further the development of their fatherland proposed establishing a state corporation for air traffic control operating on the basis of cost recovery and self-financing, which in the opinion of the initiators will by some miracle immediately solve all problems of air transportation workers, including wages and technical maintenance. I'm not even talking about reequipment, which will run into the billions. At first glance the idea is attractive and enticing, especially to the layman, and it is about its usefulness and necessity that the above-mentioned mass media are perpetually writing. For example G. Bocharov writes in his article "What Do You Make of This, Generals and Ministers?" in this year's 11 January issue of IZVESTIYA: "The most implacable opponents of these ideas (opening Russia's skies and establishing a state corporation—G.S.) are two ministries—transportation and defense. The interests of the two departments in the struggle for air traffic control in the country are dissimilar. As always, the military defend their historical right to unshared ownership of the airspace. The ineradicable Soviet psychology demands this. The Ministry of Transportation has different reasons." Continuing, he lists them, now taking jabs at former Minister of Transportation V. Yefimov: The great amounts of money involved, and the fact that if the state corporation were to be established, Rossvyonavigatsiya would drop out of the ministry, and together with it, other services. Yefimov would then be left with only the railroaders and motorists, and this would be disaster, the author prophesies. Commenting on P. Grachev's letter to O. Soskovets, which says that reorganization of the Unified Air Traffic Control System (YeS UVD) would be nothing other than transfer of the responsibility for use of the country's airspace from the Ministry of Defense to a commercial organization, and that this would lead to disintegration of the unified military-civilian air traffic control system of the Russian Federation, which has been functioning effectively for over 20 years, G. Bocharov reminds us: A state air traffic control corporation would be more than just a street vendor—it would be a joint-stock company, with 100 percent of its shares belonging to the state, and not only would it relieve the state budget of the burdensome expenses of maintaining the air traffic control system (including in the military sector), but it would even strengthen the role of the state per se in its activity.

Is this the way things are in fact?

An interview with Major General of Aviation Boris Kushneruk, chief of the administration for use of the airspace and air traffic control of the RF Ministry of Defense, and his deputies, left the glowing forecasts painted by Bocharov in the newspaper totally unsupported, to put it mildly. Moreover the biases shown by the author provide the grounds for suggesting that he is engaging in conscious speculation. Because in principle, the military are not against the idea of establishing a state corporation for air traffic control: they simply suggest making a realistic comparison of the income and expenses before taking on the project. When they did make the computations, they found that given the way things were in 1995, even if all of the indicators were the best the state corporation would not reach a self-financing position until at least 7.5 years hence. Furthermore, how could the military not think carefully about the project on reading the corporation's draft charter, which says in black and white that putting part of the shares up for sale will be permitted? Naturally, this would be only with the best intentions—attracting investments for this program's implementation. But what would be the upshot? It would be this: through the technical resources that support flying, we will be selling the airspace! This is impermissible from the standpoint of national security and the country's defense. And this is not to mention that were circumstances such that the corporation needed to be put on the auction block and sold for its debts, we would end up under foreign skies.

Next, the military, and particularly the country's air forces, feel that were such a corporation to be established, it would have to take the form of a totally state-owned enterprise, in which all property would be concentrated in the hands of the state and of only those enterprises to which control functions are delegated. This would make it possible to centralize the powers presently granted to a number of services of the Ministry of Transportation, and improve coordination of the military with these organizations, inasmuch as decentralization would be eliminated and the rended horizontal ties would be mended. Sounds logical? It does, but our colleague from IZVESTIYA makes some bold accusations: "Everything that happens in Russian skies rests upon the fully determined interests and ambitions of the

country's top military and civilian bureaucracies." Nor does he shy away from even more-biting epitaphs in the address of the military: They are "absolute simpletons" for going along with V. Yefimov, whose interests can only be said to be "mercenary." And so on, in the same spirit.

Arguing in favor of open Russian skies, which would supposedly bring us large dividends, IZVESTIYA pursued a fully definite goal: "punishing" dissident Transportation Minister Yefimov, who dared to openly state in his letter (published earlier in the same newspaper) that the term "open skies" means that anyone would be able to fly anywhere in Russian skies, and that what was actually going on was a fierce struggle between the major systems for reshuffling of the world market of aviation industry and air services.

The question that begs itself is this: Is this not why V. Yefimov was relieved of his position?

Today's "champions" of state interests have sold off almost all of our wealth, except that for some reason this filled not the coffers of the country but the purses of the "chosen ones," the "new Russians." One last thing is left for sale—Russia's skies. Those same "champions" for a glorious democratic tomorrow will rake in the money from this operation, and a good deal of money at that. It is because their slick plan met the resistance of those to whom the motherland is truly precious that these people have raised such a ruckus in the mass media.

For the moment, the currently effective law on use of the country's airspace protects it from unrestricted penetration by foreign commercial companies. Consequently our monopoly on our sky is an obstacle to trading in the airspace. And of course it's an irksome obstacle, because the sky represents enormous capital, considering that all of the shortest routes between Europe, Japan, Malaysia, and Australia cross the Soviet Union. Northern routes are always shorter than southern ones, and for example if we need to reach some points in North America, it would be better to use our airspace. Naturally all Western airline companies would like the possibility of unhindered access to Russian skies. From the times of Soviet rule and to this day, initially the military and later on civilian aviation protected the sky from penetration by foreign airplanes, and permitted their movement through it only along specific routes avoiding military facilities and the principal "highways" flown by military aviation, thus ensuring flight safety to one degree or another, and of course, the country's security in general. This is because every flight of a foreign airplane over our territory would provide an opportunity to collect highly important intelligence: flying through, such an airplane would record all of the radar and radio background. Several such flights would make it possible later on (after the air defense system is known) for foreign aviation—both bomber and strategic—to travel freely through all of our space.

Were Russian airspace to be opened, our air forces would find themselves in a fatal, catastrophic situation, because for safety reasons they would be compelled to coordinate their flights and exercises with flights by foreign airplanes. In this way, military aviation would find itself in untenable conditions, not to mention what this would do to state security. And in the words of former Transportation Minister Yefimov, the shipping volume of civil aviation could fall, and air transportation would cease to be used altogether in a number of regions of the country. In the fight for Russia's skies, interested persons are not embarrassed to suggest that Russian aviation is dangerous to life, and that air traffic control resources cannot ensure safety. However, after inspecting the flight safety system in several regions of the country, an authoritative commission from the U.S. came to the conclusion that they meet ICAO requirements. If Western liners appear in our airspace, flying wherever they wish and in any number, taking advantage of the presently difficult financial and economic position of the country, then Russian airline companies will find themselves left out in the cold, and together with them, all of the country's aviation industry. And of course there can be no doubt at all that ticket prices will go sky high. The example of pharmaceuticals fits here like a glove: crowding Russian pharmaceutical products out, they flooded the pharmacies with foreign drugs at unimaginable, fantastic prices, and sometimes even supplied outdated drugs, while reducing sales of ours to naught.

Competition is a brutal thing; in it the struggle proceeds by all means available, no means are shunned, because huge amounts of money are at stake, and self-made businessmen are trying with all of their strength to tear off a richer chunk, and so that this pilferage would appear presentable, they clothe their actions in the garments of "concern for the people," allegedly for their well-being and security.

The idea of open Russian skies and establishment of a state corporation as a joint-stock company are directly associated with the main goal: selling the last of what Russia has—the air of the fatherland, for short-term gain with not a thought to the future.

And as for the "millions of people" about whom the author from IZVESTIYA is so "troubled," and to whom he appeals so pathetically for help in implementing the program of confiscating our skies, his general attitude is business as usual—the hell with them.

Russia: World Rocket Booster Market Evaluated

964D0586A Moscow SEGODNYA in Russian
5 Mar 96 p 11

[Article by Konstantin Lantratov and Vladimir Sergeyev: "In Return We Make Rockets. Present Status of International Market for Light Space Boosters"]

[FBIS Translated Text] The last decade has been characterized by the appearance of so-called minisatellites on the commercial space launch market. These are small vehicles whose weight varies from several tens to several hundreds of kg. Due to the broad application of the modern advances in microelectronics, they are capable of performing quite diverse functions. There are scientific vehicles studying the Earth, circumterrestrial space and small interplanetary stations studying the universe, and low-orbit communication satellites. The latter are now evoking the greatest interest among representatives of business circles. Several variants of low-orbit satellite systems providing both radiotelephonic and intercomputer communication have now been developed. Although the market for such satellites is still quite young, the range of companies capable of occupying key positions on the market for launches of small space vehicles, promising an attractive future, has nevertheless already been determined. It is gratifying to note that there are Russian firms among these companies.

Minisatellites can be put into orbit by two methods. The first is to put them as an incidental payload on heavier spacecraft launched by heavy-or medium-class boosters. But in this case the separating minisatellite remains in approximately the same orbit as the main launched vehicle, and if other orbital parameters are needed for the minisatellite, the latter must carry its own engine. This may transform a light satellite into a quite large space vehicle. A second method of launching minisatellites is the use of a light booster. It is the preferable method: The satellite will be put into that orbit which is best for its full-fledged functioning.

Applying entirely understandable technical and economic reasoning, it has become world practice to build light space rockets on the basis of military ballistic missiles. Some of the old light boosters developed during the earliest space years no longer are being used; some of them, such as the Russian Kosmos-3M, are characterized by an enviable longevity; and many are only taking their first steps, to be more precise, are making their first flights; and there are still more projects for light boosters.

Kosmos-3M — Reliability Better Than the Price

Among the Russian (and not only Russian) light space rockets, the unquestionable leader is the Kosmos-3M booster. It was designed in the mid-1960's on the basis of the R-14 (SS-5) medium-range liquid-propellant ballistic missile (developer — OKB [Special Design Bureau] 586/Yuzhnoye Design Bureau, Dnepropetrovsk). The standard production of the two-stage Kosmos-3M booster is at the Polet Aerospace Association (ASA) (Omsk). A total of more than 750 different boosters of the Cosmos series have been produced there. Boosters of this type have been launched from the Baykonur cosmodrome, as well as from the Kapustin Yar launch site (Astrakhan Oblast), where there are now two unused space launch facilities.

The first launch of the Kosmos-3M booster took place at Plesetsk on 10 May 1967, and thereafter it was used repeatedly during the days of the USSR for the launch of foreign spacecraft, to be sure, without cost, that is, free of charge. For example, they were used in the launch of three Indian satellites: Anabhata (13 April 1975) — the first national Indian satellite, Bhaskara-1 and -2 (7 June 1979 and 20 November 1981 respectively, the French Signe-3 artificial satellite (17 June 1977), as well as numerous spacecraft of the Intercosmos series (Nos 10, 12-15, 17-21) during the period 1973-1981. In addition, under the French Arkad project two Aureole satellites were launched from Plesetsk (27 December 1971 and 26 December 1973 respectively). All the international launches were successful, other than one, when a Kosmos-3M booster being launched from Kapustin Yar on 3 June 1975 experienced an accident, burying beneath its fragments a satellite with Swedish instrumentation.

However, the commercial use of the Kosmos-3M booster began only in January 1995. Then, together with the principal payload, the Tsikada navigation satellite, two minisatellites were launched: the American experimental communication satellite Faisat-1, belonging to the company Final Analysis, Inc. (FAI), and the Swedish scientific satellite Astrid, developed by the Swedish Space Corporation and the Swedish Space Physics Institute.

The cost of the launch was not announced at that time, but a FAI representative noted that Russian launches are by no means "cheap," particularly if one takes into account all the additional expenditures associated with conducting business in Russia. The attractiveness is not in the price, but in the high reliability of the Kosmos-3M booster and in the possibility of executing a launch in a short period of time. FAI representatives declared that they would like to use the Omsk booster for the deployment of the entire low-orbit communication system of 36 satellites of the Faisat series over the course of six years. At the Polet Aerospace Association (ASA), work is now being done on exploring the

possibility of launch of groups of five to seven satellites in one booster launch. Also being considered are some other proposals of foreign clients for launches with the Kosmos-3M booster. Late last year Sergey Osmolskiy, Polet director, reported that the association had signed a contract with one of the well-known German companies for the launch of a German satellite by a Kosmos-3M booster.

According to unofficial data, the cost of launch of one Kosmos-3M booster is $12-16 million. In contrast to many new light boosters, in the case of the Cosmos it is possible to speak of booster reliability because there are statistics for a great number of its launches. During the 1970's-1980's this type of booster was constructed and launched at a rate up to 40-50 per year. If the entire period of booster operation beginning with 1967 is considered, the reliability of the Kosmos-3M booster is 94.2 percent, although an evaluation for the last decade gives a still higher reliability.

The Kosmos-3M has almost the best possibilities for servicing the market for launches of small spacecraft. Having a lift up to 1,100 kg, this booster by itself will handle virtually the entire range of masses of small vehicles anticipated in the very near future, a task to which several new competing American, and in the future, also European light boosters, are laying claim at the same time. The Kosmos-3M, even with the evening-out of internal Russian prices and world prices, will realistically make it possible to keep the cost of a launch at a level somewhat lower than for new competing Western boosters.

Circuitous Paths

However, the problem with commercial launches of the Kosmos-3M most likely is linked to Western clients. American aerospace companies are the principal developers of commercial spacecraft. They themselves are either developers and builders of rocket-space technology or are very closely associated with such corporations. Accordingly, to make a breakthrough to the launches market the Russian companies must, in collaboration with the Americans, set up joint enterprises, allocating part of the profit in the search for orders and, putting it roughly, authorization for the launch of American satellites. It is an extremely complicated matter for an independent national non-American company to enter the international commercial space launches market. This is apparently one of the principal problems of the Polet Aerospace Association.

Accordingly, considerably more commercial orders can be expected for the new Russian Rokot light booster, developed on the basis of the RS-18 (SS-19) IBM. Its developer and builder, the State Space Scientific Production Center imeni M.V. Khrunichev (SSSPC), in May 1994 signed an agreement with the German company Daimler-Benz Aerospace AG (DASA) on establishing the joint enterprise Eurockot, whose objective is the marketing of Rokot booster launches of communication satellites weighing up to 1.85 ton. The State Space Scientific Production Center imeni M.V. Khrunichev must carry out technical adaptation of its booster to meet Western standards.

The Rokot is a liquid-propellant two-stage RS-18 IBM with an additional Briz propulsion unit. There now have been three completely successful launches of this booster from silos at the Baykonur cosmodrome, two on a ballistic trajectory and one on an orbital trajectory. No more Rokot launches from the southern cosmodrome are anticipated. One ground launch complex for this rocket booster at the Plesetsk cosmodrome is planned, having reequipped one of three Kosmos-3M rocket booster installations. The first Rokot launch from this facility is planned for 1997. According to Eurockot plans, two Rokot launches will occur in 1997 and four in 1998. Starting in 1999, Eurockot plans to do six commercial launches a year. In addition, Russian military space forces are planning to reoutfit five silos at the new Russian cosmodrome Svobodnyy for the RS-10 (SS-11) IBM for Rokot launches.

Stationary launch facilities are not needed for the new family of solid-propellant Start boosters. This space booster inherited mobility from its prototype — the RS-12M (SS-25) IBM of the Topol rocket complex. The rocket in its container with the light "corona" sectional launch structure can be delivered to any point on the planet. The Kompleks Science-Technology Center developed the family of Start boosters. This is an independent enterprise established especially for the conversion of the development work of the Moscow Heat Engineering Institute — the leading developer of mobile military rocket complexes 9K76 "Temp-S" (OTR-22, SS-12), "Pioneer" (RDS-10, SS-20) and Topol (RS-12M, SS-25).

Now the Kompleks Science-Technology Center has developed two booster variants — the five-stage Start-1 (lift 390 kg into a low circumterrestrial orbit), whose first launch took place successfully on 25 March 1993, and the six-stage Start (600 kg into a low orbit), the first launch of which on 28 March 1995 ended in an accident.

Both Start family booster launches were carried out in conformity to the combat calculations of the Strategic Rocket Forces from the Plesetsk rocket test site. Now consideration is being given to the possibility of launches of boosters of this type by the military space

forces of Russia from Svobodnyy cosmodrome. There have been no official communications on the cost of these rocket booster launches. However, it is known from unofficial sources that the launch of the 55-kg Israeli satellite Gurvin-Techsat-1 on 28 March 1995 cost $0.25 million. If it is taken into account that an advantageous tariff applied for the test launch of the booster, the launch of a 600-kg vehicle with the Start may cost $3-5 million. The list of potential clients of the Start booster is rather long: it includes clients from Australia, Canada, United States, France, Sweden and South African Republic. Australia and Canada are ready to make their territory available for launches of these transportable boosters. According to an assertion from a representative of the Kompleks Science-Technology Center, none of them reconsidered their intentions after the accident of 28 March 1995. At this time the company has contracts for the launch of three satellites: the Israeli Gurvin-Techsat-2, the Swedish ODIN and the American Worldview. The latter is to be launched in the fourth quarter of 1996. It should be the first to be launched from the new Russian cosmodrome Svobodnyy (Amur Oblast).

Transoceanic Competitors

American companies are the principal competitors of the Russian companies which are producing light boosters. All the American boosters, in contrast to Russian boosters, operate on solid fuel. The Americans also have worthy representatives in the light booster class. One of them is the Scout, which is produced by Loral Vought Systems. The Scout is the clearest example of the building of a new booster from elements of already operational ballistic missiles and space rockets; its first launch took place on 18 April 1960.

NASA has worked with this booster regularly since 1963. The booster has been used in almost 20 variants. The Scout has been launched from the Wallops Island launch site (since 1960), from a western test site (since 1962) and the Italian marine astrodome San Marino (since 1967). For the most part the boo r has been used for the launching of light satellites, of which almost 100 have been launched. Due to the use of the already tried and true material part, standard construction and launch process, it was possible to increase booster reliability to 98.3 percent. The last accident occurred on 5 December 1975 and the last Scout launch was on 9 May 1994.

Now a variant for the renewal of production of boosters of this type called the Scout-2 is being considered. Taking into account the production process, which has been well worked out, it will be easy to organize their production.

A booster of the Pegasus series became a serious contender for the leading role among American light boosters after the departure of the Scout from the stage. The Orbital Sciences Corporation is engaged in its development and production. In contrast to all other boosters, the Pegasus is not launched from a surface pad, but from aboard a reequipped B-52 bomber at an altitude 13 km. All four booster stages operate on solid-propellant fuel. The Pegasus booster has a lift of 320 kg, the Pegasus XL variant — 450 kg. In launches of boosters of the Pegasus series the B-52 and L-1011 mother aircraft took off either from the Air Force base at Cape Canaveral (Florida) or Edwards and Vandenberg Air Force bases in California. The booster is usually separated from the mother aircraft over the ocean.

The first launch of the Pegasus was on 5 April 1990 from the Pegsat and U.S. SS satellites. As of now there have been seven Pegasus launches (of which one was partially successful) and two Pegasus XL launches (both involving accidents). Now the Orbital Sciences Corporation has contracts for the launch of 30 satellites by boosters of the Pegasus series before the beginning of 2000 and plans to win contracts for an additional 27 launches of their boosters during the period from 2000 to 2004. Despite the two recent Pegasus XL accidents, during 1995 the company succeeded in increasing the amount for the contracts which it had signed by a factor of 2.8 in comparison with 1994. Now this amount is $50 million.

The Orbital Sciences Corporation developed, built and on 13 March 1994 launched the light booster Taurus with two experimental military satellites. The booster has four solid-propellant stages. The Taurus can be called the American Start because its prototype was a ballistic missile: the first stage is a TU-903 rocket, constructed on the basis of the MX intercontinental ballistic missile. The second, third and fourth stages are modifications of the first, second and third stages of the Pegasus booster respectively. For the time being the sole launch of this booster has been from the Vandenberg Air Force Base.

The Taurus, like the Start, belongs to a new generation of boosters which can be launched from any stipulated point on the earth with a small number of servicing personnel. It does not require stationary bases and launch facilities. The only thing which must be at the launch site is a reinforced concrete area capable of supporting the weight of the rocket. In finalizing preparations for an impending launch, American military specialists ascertained that a launch of this rocket can be made ready within eight days after arrival of launch equipment. Among the impending launches of the Taurus booster there is mention only of a single Clementine-2

vehicle. Evidently, for the time being, potential clients prefer cheaper light boosters. Possibly the protectionism of large American companies also plays a role here.

An example of this may be the family of solid-propellant LLV (Lockheed Launch Vehicle) boosters, recently renamed the LMLV (Lockheed Martin Launch Vehicle) as a result of the merging of the Lockheed and Martin companies. Although the first launch of a rocket of this family, the LLV-1, on 15 August 1995 also ended in an accident, the booster builder Lockheed Martin Missiles & Space is confidently planning on carrying out 10 launches of rockets of this series before the year 2000. Contracts have already been signed for six launches. Among these there are both NASA vehicles (including the automatic interplanetary station Lunar Prospector) and commercial satellites of the United States and Taiwan. After the LLV-1 with a payload of 900 kg the company intends to construct the LLV-2 with a payload of 1,800 kg and the LLV-3 with a payload 3,600 kg. For the time being the first and only LLV-1 launch has been from the American Vandenberg Air Force Base.

Characteristics of launches of light boosters

Name	Country	Manufacturing company	Maximum payload weight, kg	Cost of launch, millions of dollars
Scout	USA	Loral Vought Systems	200	10-13
Pegasus	USA	Orbital Sciences Corp	450	10-14
Taurus	USA	Orbital Sciences Corp	1,450	20-25
LLV-1 (LMLV-1)	USA	Lockheed Martin Missiles & Space	900	16
Conestoga	USA	EER Systems, Inc.	1,180	14-20
Kosmos-3M	Russia	Polet ASA	1,400	12-16
Rokot	Russia	M. V. Khrunichev SSSPC	1,850	-
Start	Russia	Kompleks Science-Technology Center	600	-

The "biography" of the commercial Conestoga booster, produced by EER Systems, Inc. (Vienna, Virginia), began as unsuccessfully as the LLV-1. On 23 October 1995 it was launched from the Wallops Island launch site (Virginia), went out of control and was blown up by command from the ground. NASA played a considerable role in implementing and funding the project for building this booster.

Statistical data on launches of light boosters

Name	Use period	Successful	Partially successful	Accidents	Total
Scout	1960-1994	100	1	17	118
Pegasus	Since 1990	6	1	2	9
Taurus	Since 1994	1	-	-	1
LLV-1 (LMLV-1)	Since 1996	-	-	1	1
Conestoga	Since 1995	-	-	1	1
Kosmos-3M*	Since 1967	392	7	17	416

Name	Use period	Successful	Partially successful	Accidents	Total
Rokot	Since 1990	3	-	-	3
Start	Since 1993	1	-	1	2

*Data only in the interests of implementation of space programs.

The solid-propellant Conestoga booster, model 1620, has a rated payload of 1,180 kg. Its development cost EER Systems $100 million. For the time being the press has mentioned only the MSTI-5 (Miniature Seeker Technology Integration) spacecraft, whose launch is to be carried out using the Conestoga booster. It is evident that EER Systems, Inc., does not operate on a par with Lockheed Martin in the struggle for commercial orders.

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Japan with its U-1 booster (the first flight was made on 12 February 1996) and China with boosters of the CZ "Great March" series may get into the distribution of contracts in the light boosters market. The countries of Western Europe, working in close cooperation in developing the ESL (European Small Launcher) booster, also do not wish to yield this market. It is theoretically possible that such countries as India and Israel may enter the international market. However, these at present have only projects and plans, the same as the infinitely great number of projects for light boosters proposed by Russian companies — producers of rocket technology. A review of these plans and projects would require 10 times more space than occupied by this article. During the present period, so tough for our "defense industry," these enterprises to some degree are involving themselves in rocket technologies, are striving by means of such projects to interest the West at least to some degree and straighten out their financial situation. Most of them, judging from everything, will remain projects, although some of them may possibly reach the flight stage.

Russia: Lavochkin NPO Future Directions Outlined

964D0749A Moscow KRASNAYA ZVEZDA in Russian 30 Mar 96 p 4

[Article by Mikhail Rebrov: "NPO imeni Lavochkin: Where Will Vector of Hope Turn?"]

[FBIS Translated Text] *There is a small area in the NPO [Scientific-Production Association] imeni Lavochkin where models and full-scale "articles" (working, for the most part) for airplanes, missiles and spacecraft are exhibited among numerous portraits collected over six decades ("the firm's leading people"). I have no wish to yield to the hypnosis of nostalgia, or to project the past upon the future. People I interviewed regarding the "firm's" present said alarming and even saddening things: development of new engineering ideas, scientific concepts, and approaches to design strategy remains the main thing. But the accents have shifted. While the enterprise is state-owned, the state has cancelled its contributions. All that's left is enthusiasm. Except that you can't fly to outer space with it, and it doesn't go very far in near space either.*

In Latin, "engineer" means talent, thought, ability. Today we should add to this: unflinching courage in the face of problems. Even in the past, the NPO had to prepare itself for all kinds of surprises. This helped it to survive in a time when projects that won the competition—military and civilian (La-200, K-15, Burya, Dal, Lunokhod-3, the lunar observatory)—had to be worked on in secrecy.

Working for Science and Defense

Few today remember when the automatic laboratories Astron, Granat and Prognoz were launched to their orbits. They continue to work in space even though they have 5, 10 and more years behind them. And whoever heard about the projects Zerkalo, Nord and Arkon-1? Or about the Marsian rover developed by Lavochkin's NPO? This Marsian mobile researcher was not only manufactured but also underwent testing on a special range to which the control commands were transmitted from another continent, from the U.S.

In the 30 years of space research 63 automatic scientific research stations were launched toward the Moon, Venus, Mars, and Halley's Comet, and near-Earth laboratories were created. What did all of this give to science? The extremely valuable scientific information added to the treasure-house of human knowledge cannot be described in a newspaper article, or measured in rubles. What did all of this give Russia? Seven world firsts—things that have been documented and recognized by everyone living on the planet. Another four that could have been firsts were lost due to the sluggishness and slowness of "the bureaucrats of cosmonautics" (that kind of bureaucrat exists as well).

Much was done by the Lavochkin firm for the country's defense. Not only during the war and in the years preceding it (the firm has its origins in the secret

Military Plant No 301, established by decision of the Labor and Defense Council on 1 July 1937), but after it too. Even today, orders of the Ministry of Defense are being filled not only on a substantial quantitative scale but also with a kind of quality that allows us to assert that our firsts in this field are unchallenged.

But this subject matter is, as they say, "not for public viewing," and therefore we shouldn't "look through the cracks."

Three Main Directions

I'm not saying that developments in the interests of the Russian military department have no practical applications. On the contrary. And this, I feel, is understandable. The Lavochkin NPO is seeking its niche in the marketplace without retreating from the main principle mentioned above. As I was told by first deputy chief designer Stanislav Kulikov, the firm's workers are able to do everything well (considering the firm's scientific-technical potential, its production and testing base, and the people's qualifications), but for the time being they have chosen three basic directions.

The first is communications. This includes satellite systems—"global" and "local," and a space air traffic control system ensuring safe passage for 3,000 airplanes (by the way, this project was also landed with a winning bid, but as they say in that song, "we won't be getting all the money"). The Bankir (Banker) satellite system was developed on order from the Central Bank. This system provides information support to all banking and trading organizations, and it provides for a transition from "paper" technology to electronic, shortening of all operations to just seconds, guaranteed confidentiality, and dependable protection. Three satellites in stationary orbit are able to link together 40,000 banks (20 percent of the system's resources). The first of the three satellites—Kupon—has already been created. As for whether such a system is needed by Russia, this question could be answered as follows: Because money is in transit for a long time, the losses to the country total 3-5 percent of its gross product.

The second is monitoring the Earth's surface, ecological monitoring of the planet. On-line! Cataclysms occurring in one area have their effects in another. Any delay in notification harbors large losses. Consider forest fires. The amount of forests that burn today in Russia equals what we harvest as wood. Workers of the NPO proposed project Plamya (Flame)—a closed satellite system able to detect a forest fire covering an area of 10x10 meters from orbit. If this task were to be carried out by patrol airplanes and helicopters, it would take billions of rubles to detect just a single "hot spot." All of the expenses of creating the space system may be recouped in 2 years.

The Lavochkin NPO has agreed to accept timber for its work, on the assumption that it would be able to sell it. But things aren't all that simple in our "unique economic conditions." In its essence, however, this idea is logical.

The third is development of production processes in space, or acquisition of ultrapure materials (for electronics industry and medicine) and materials with prescribed properties (there are plans for the Frakht specialized production module and for apparatus for experimental production). This idea is a profitable one, especially if converted rockets are used (the RS-20 and others).

A Quick Look at the Past

Many years ago I had the occasion to meet general designers S. A. Lavochkin, G. N. Babakin and V. M. Kovtunenko. On the present trip I met Oleg Ivanovskiy (he started back under Korolev with the first satellite and the first Vostok), Feliks Babich (he worked on the lunar programs), and other developers. But limiting the story to the firm and its developments would mean omitting one important and fundamental point.

Airplane Building Plant No 301 was set up on the grounds of the Khimki Furniture Factory. Let me add that this was a special plant. Its officially announced role was to supply products for construction of the Palace of the Soviets on the site of the Shrine of Christ the Savior. But instead of furniture, the conveyer actually produced Lagg and La aircraft. LaGG-3, La-5 and La-7 fighters were called the "three soldiers of war"—more than 22,000 of them were built. After the war the factory manufactured the La-11—a long-range escort able to remain in the air for 6 hours (these aircraft were based on drifting and ice airfields and covered the northern borders until 1980). The La-160 was the first swept-wing jet, the La-176 reached the speed of sound back in 1948, and the La-250, which is a supersonic airplane with radio-controlled missiles, was manufactured by this firm as well (it was called the Anakhonda).

Surface-to-air guided missiles of the Dal air defense system were launched from an inclined position, and they were equipped with computers making it possible to simultaneously track and guide 10 rockets to 10 targets. The Burya cruise missile, which had an astro-navigation control system that was absolutely immune to jamming (a worthy analog never was created abroad) flew 17 flights (the "aiming" point was the vicinity of Kamchatka). There are also the La-17 automatic targets. The firm was the first to use laminated plywood to build airplanes, and it was where the advantages of titanium metallurgy (stamping, welding) were demonstrated.

I am not going to go into the first steps of the assault on the Moon, Venus and Mars. This is a special page in the firm's history. The Lavochkin NPO is not the only organization making different kinds of satellites today. Other firms are also doing this, and some are even competitors. But let's be fair: no one has reached beyond stationary orbits besides Lavochkin workers, and the conditions out there, and on long flights, and upon returning from them, are such that you have to know how to ensure the reliability and performance of the spacecraft.

Let me add that the excellence of aviation production lies not only in high technology but also in traditions, which are protected here as something precious. In round numbers, 10,000 people work at the firm.

Projects for Tomorrow

I deliberately left discussion of the "commercial troubles" of the Lavochkin NPO to the last. They were related to me with absolute openness. I am not going to go into the details—all of this has nothing to do with the subject at hand. Briefly, they raised their hopes too high, they were deceived, and they got burned—such are the times. But the damage was done, and it probably won't be corrected right away. However, the work is continuing. I am referring to the main work—on the ground and in space. And the projects that are being advertised and carried out are significant. Besides those above, let me mention the Spektr observatory, the Fregat booster stage, and the Mars-96 automatic scientific research station (more precisely, a space complex).

By the way, the Fregat (ordered by the Russian Space Agency and the Ministry of Defense) can solve the problem of reequipping Plesetsk Cosmodrome as Russia's main spaceport.

Although we've run aground when it comes to money, we continue to go forward, because the work is so damn interesting"—so say many people at the firm, both engineers and workers. Where will the vector of hope turn? I think that like with the pointer of a barometer, after wandering back and forth a little, it will point to "Clear."

Russia: Baykonur Modernization for Mir Needed

964D0749B Moscow KRASNAYA ZVEZDA in Russian 23 Feb 96 p 3

[Article by Anatoliy Ladin: "Baykonur Will Go on Working Long and Hard: Kazakhstan President Nursultan Nazarbayev Meets With Energiya NPO General Designer and General Director Yuriy Semenov and Baykonur Cosmodrome Chief Lieutenant General Aleksey Shumilin"]

[FBIS Translated Text] Yuriy Semenov briefed the president of Kazakhstan on the progress in implementing the Russian-American program based on the Mir orbiting complex. In addition, Nursultan Nazarbayev asked questions about the activity of the Kazakhstan-Russian interstate company and the present problems of the Baykonur Cosmodrome.

The president was told that many facilities at Baykonur need major modernization in connection with work underway in the Russian-American project. This naturally requires sizable resources. Yuriy Semenov and Aleksey Shumilin suggested specific ways to Nazarbayev for getting the money based on utilizing the possibilities of the cosmodrome itself.

Aleksey Shumilin noted in an exclusive KRASNAYA ZVEZDA interview that the agreement to lease the cosmodrome and the arrangements signed on its basis open up broad possibilities. In this connection it would be suitable to give Baykonur the status of a federal cosmodrome, and establish its financing as a separate, protected item in the Russian budget, with the resources being distributed centrally. In his words, the agreement would make it possible to significantly improve the situation at this spaceport. Shumilin is concerned about the problem of repairing and restoring worn equipment and putting the technical facilities and launch complexes in order.

Recognizing the difficult situation of the cosmodrome today, Yuriy Semenov emphasized that besides the agreement to lease the cosmodrome, the Russian-American space project also opens up great prospects for Baykonur. Many launchings will be carried out from here with the purpose of servicing the new international space station. Such that there will be a great deal of work for a long time to come.

Russia: Mir Construction Debated

964D0857A Moscow IZVESTIYA in Russian 23 Apr 96 p 2

[Article by IZVESTIYA correspondent Sergey Leskov: "What It Will Cost Us To Build 'Mir'"]

[FBIS Translated Text] The "Proton" booster rocket, which is to put the "Priroda" module into orbit, is being launched from the Baykonur Cosmodrome on 23 April. This module is to be the last element in the "Mir" space station, which was launched in February 1986.

There are fewer expectations that Russia will be able to begin independent construction of the new orbiting complex than there are that pineapples can be raised at the

sea bottom. For this reason, launching of the "Priroda" module may be considered a symbolic event marking completion of a lengthy stage in the development of space flight. Aside from the glorified successes, there are quite a few dramatic turning points and quite a few blank spaces which await a researcher able to obtain documents that are secret even now.

The "orbital" era formally began on 19 April 1971 when the first Soviet orbiting station, "Salyut," was launched. We know that the flight by cosmonauts Dobrovolskiy, Vladislav Volkov, and Patsayev ended in their death when the spacecraft lost pressurization. Meanwhile, the valve through which the air is reduced was accessible to the crew but turned out to be hidden behind the skin. An oversight? We have heard that the "innovation" was introduced at the advice of one of the cosmonauts who had flown and was promoted to a supervisory position.

One more puzzle—the launch in the early 1970's which did not receive a "Salyut" series number. It fell apart right after entering orbit. The Soviet people were not told about this and are not reminded of it even now.

It is unclear what kind of cat ran between Volynov and Zholobov in "Salyut-5," since the crew landed ahead of schedule. There was a clear scent of decay on the ship, and the cosmonauts sat in corners far apart in order not to see each other. Vasyutin returned home ahead of time from "Salyut-7"; in Zvezdnyy he tried to persuade a private physician to conceal a chronic illness which one does not acknowledge, they say. And although there were no eyewitnesses, there is talk that the threat of mission failure led for the first time to "space" assault and battery.

The "Salyut" orbital stations were presented as the Soviet response to the Americans' flights to the Moon. The Moon won more effectively, but from a pragmatic standpoint the orbital research was no less important. But as we know now, we acted slyly—we also dreamed about the Moon but we were unable to finish building the N-1 super-rocket. But where did our response to the American lunar expeditions come from so quickly? There is an impression that completed orbital stations jumped out of Soviet KB (design bureaus) like rabbits out of a magician's hat. And this is the biggest puzzle in the Soviet orbital program.

The orbital stations were developed by the prominent designer Vladimir Chelomey, and he is the one who created the extremely reliable "Proton" rocket. But Chelomey's stations had a military designation and were called "Almazes," which are not mentioned in any space encyclopedia. So in reality the civilian Salyut-2, -3, and -5 stations were the military "Almazes." This may be assumed from indirect signs—only military cosmonauts who brought capsules with secret information back to Earth were permitted on these stations. The stations' main assignment was to take intelligence photographs of enemy territories. A camera with a huge 2-meter lens was installed in one of the "Salyuts" (that is, "Almazes"), and we showed off the photos in every possible negotiation.

The "Almaz" program was ended for two reasons. First of all, it was explained that automatic spy satellites are less expensive and provide quality information. Secondly (or first of all), Chelomey, in whose design bureau Khrushchev's son worked, by the way, saw that it was harder and harder to find a common language with the Brezhnev leadership, and relationships with Minister of Defense Ustinov had fallen apart completely.

Of course, it would be naive to say that the "Mir" station has always performed exclusively peaceful functions. There are many secrets which cannot be revealed even now. It should be said that the military department had particular hopes for the "Spektr" module, which presumably was to be loaded with reconnaissance equipment "below the waterline." The "Oktant" system and the "Pion" telescope, were to become the first element in the Soviet SOI [strategic defense initiative] to support the so-called "umbrella" program which watches all the suspicious-looking enemy facilities. But the treasury became impoverished and the SOI struggle lost its urgency. "Spektr" remained on the launchpad for 5 years and flew in its demobilized form with civilian—including Western—cargo.

It seems that it was the "Spektr" that needlessly worried the designers and cosmonauts most of all. This was the puzzle: why was the very experienced 55-year-old space ace Gennadiy Strekalov fined after the flight? A clear answer was not provided, and I refer to the official version for this reason. The powerful solar batteries were the most important thing on the "Spektr." But after it docked with "Mir," one of the halves was not extended. They had to go outside in open space to repair it. But Dezhurov and Strekalov had already gone outside on five occasions by that time. And pleading fatigue, they refused to take the unscheduled space walk. In any event, there was no zeal. Ironically, the "Spektr" is considered to be a candidate for the Russian unit on the "Alpha" international station.

How many years will "Mir" last? The guaranteed service life of the base unit and each module is 3 years. Records are pleasant, but the equipment is not permanent, all the same. The cosmonauts will spend most of their time at the station on repair and maintenance of its vital activity. The orbital station is becoming more and more like a Komsomol who existed mostly in order to serve himself.

Something else is working—the "Rentgen" telescope on the "Kvant," the "Optizon" installation on the "Kristall," and equipment on the "Spektr," aside from the fact that foreigners regularly bring instruments with them. And the space motorcycle which we were so proud of and which we rode once, although while it was running, has become unneeded. It was taken from the station and attached to the "roof." We have a suggestion for the Americans: take it away in the "Shuttle" and sell it at some auction.

The Americans and, separately, the Japanese, the representatives of other, dissimilar cultures, considered it right and proper to come up with the money and are designing their own stations, and they are calling on us for assistance. They are buying it very cheaply—that is the problem. But the fact is that others have come forward in the orbit opened by "Mir."

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- The orbital station includes the modules "Kvant" (launched 31 March 1987, "Kvant-2" (launched 26 November 1989), "Kristall" (launched 31 May 1990), and "Spektr" (launched 20 May 1995).
- The total mass of the orbital station with two docked transport ships and the "Priroda" module is about 140 metric tons.
- The linear dimensions are as follows: about 33 meters on one axis and 42 meters on the other.
- There have been 56 persons on the station over the 10-year period.

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- The "Priroda" module is 11.5 meters long and 4.1 meters in diameter. It has a mass of 19.5 metric tons and a payload of 6.5 metric tons of cargo and scientific apparatus, most of which is carried under contract with NASA.
- It was planned to launch the "Priroda" module with domestic equipment in 1992, which UNESCO had named Ecology Year. But because of financial problems associated mainly with the previous "Spektr" module, the launch was delayed.
- The module was preserved all these years, and after checks of thousands of instruments, only two were replaced.
- Docking with "Mir" was planned for the fourth day of flight. Because of the collapse of cooperation, the module was launched first without solar batteries, which had been manufactured in Ukraine. This sets strict requirements for accuracy in docking with "Mir."

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- The idea of orbital stations was taken up by the "Energiya" NPO [Scientific Production Association]. Today it is impossible to determine who is the main one. In putting the station together a special staff travels back and forth regularly between one point and another.
- Russia's "Energiya" space complex determines the tasks for the station and puts the scientific program together. The State Space Scientific-Production Center imeni Khrunichev (one of the enterprises in the former Chelomey reign) carries out all the technological and operational tasks and manufactures the station itself.
- Experience in working on the "Salyut" and "Mir" stations forced the Americans to suggest collaboration with these enterprises in the program for the international space station "Alfa."
- No matter how high-flown this sounds, it must be acknowledged that in our state, "Khrunichev" and "Energiya" are among those few enterprises which work for the state's prestige.

Russia: Interball Project Threatened by Funding Shortfalls

964D0688A Moscow SEGODNYA in Russian 4 Mar 96 p 4

[Article by Mikhail Chernyshov: "Dark Spots on the Sunny Face of Project Interball: Russians Again Threatened by Rocket Starvation"]

[FBIS Translated Text] Plasma emanating from the Sun is often called solar wind. It consists of an extremely rarefied substance. If someone were able to collect all of this solar plasma, said Lev Zelenyy, scientific coordinator for project Interball, he would wind up with only a few kilograms of matter. Nonetheless, such a negligible quantity of a substance that occupies a huge area has a great influence on Earth. Interacting with the Earth's magnetosphere and the upper atmosphere, the flows of solar wind evoke weather and climatic cataclysms on our planet, and affect the work of electric power transmission lines, radio communication and television broadcasting. World science has long been advertising plans to create a vast observation network consisting of several spacecraft able to measure the characteristics of solar wind in the neighborhood of Earth.

The U.S., Japan and Western Europe are working on several such projects. The Russian program, which is being carried out in cooperation with more than two dozen other countries, is called Interball. Four spacecraft were created under the program. Two of them—large

stations weighing a tonne and a half based on Prognoz satellites—were made by Russia, and two small Magion satellites of 50 kg each were made by Chechnya. The large and small craft are launched in pairs. One rocket is needed for each pair. And it is the launch vehicles, or more precisely their absence, that have become the main problem for Interball. The difficulties encountered by scientists in preparations for launching the first pair of satellites last year were described in the newspaper SEGODNYA (No 95, 1995). The Russian Federation's Military Space Forces were able to get a launch vehicle from some mysterious source and launch the first two probes, Interbol-1 and Magion-4, onto a highly elongated elliptical orbit reaching 200,000 km away from Earth. This orbit makes it possible to study the magnetosphere's "tail." The satellites have now been supplying information to scientists for several months. In Lev Zelenyy's words there are no scientific problems with the tail craft, but there are difficulties in financing the work, though this month the Russian Space Agency seems to be promising to appropriate the needed resources to support work with the satellites already in orbit.

However, the main difficulty, one which puts the fate of the project as a whole in question, is launching the second pair of satellites, Interbol-2 and Magion-5, into the so-called auroral zone of the magnetosphere. The orbit of this pair of satellites must be lower, with an apogee of just 20,000 km, and consequently a rocket of relatively low power that can be launched from Baykonur or from Plesetsk is needed. It is important for the satellites to start working by September or October. The situation is not as yet tragic. All interested departments—the Russian Space Agency and the RF Aerospace Forces—seem to be promising support to the project. But the main thing is still lacking—there is no money for the launching, and the rocket itself is missing. If the issue is resolved at the last moment, as happened last year, additional difficulties will arise due to overlap of the Interball and Mars-96 projects. There are a number of specialists working in both projects who will not be able to prepare simultaneously for the launching of two different spacecraft.

Interbol-2 and Magion-5 have to be launched in summer, and if this doesn't happen, the difficulties, both internal and foreign, will start to multiply. The Interball system is designed for 3 or 4 years of work, and perhaps even more. It will be maximally useful if it is able to operate jointly with the spacecraft of other countries—the Japanese-American satellite Geotail, and the American craft Wind, Polar and Soho, which are already in orbit. By the way, Polar was also late in taking its place in space. Launching of the Western European probe Cluster is anticipated. Absence of the second "Interball pair" will mean formation of a "hole" in the overall measurement system. Besides everything else, this will mean that 16 years of work by all of the program's participants would have been wasted.

Russia: Khrunichev Participation in Iridium Project Described

964D0688B Moscow KRASNAYA ZVEZDA in Russian 24 Feb 96 p 4

[Unattributed article: "Investments Into Space Project Increased"]

[FBIS Translated Text] The company Iridium, Inc. reported initiation of the next phase in financing of a space project of the same name, in which the Russian State Space Scientific-Production Center imeni M. V. Khrunichev is participating. The total amount of investments has now increased, and it will be over $1.9 billion. An additional $315 million are reserved for creation of a global mobile satellite communication system by an international consortium under the leadership of Motorola.

Commenting on these decisions, Iridium's chief executive Robert Kinsey stressed that the additional monetary sum demonstrates the continually increasing strength of the program and once again confirms the reliability of obligations assumed by the group of investors. It was also announced that by unanimous decision of its Board of Directors, Iridium Inc. has agreed to sell the right to provide the system's services to a territory embracing Australia, New Zealand and nearby islands. And there already is a powerful group of investors that has reserved these regions for itself.

According to the plans, the Iridium system is to begin operating in the third quarter of 1998. It will provide a wide assortment of communication services, including digital, telephone, duplex, paging, etc. The Space Center imeni Khrunichev is to complete the work of providing technical and legal support to the Iridium system's operation on apportioned territories, including purchase and construction of base tracking stations, and acquisition of licenses to operate and organize a network of suppliers of the system's services. The Russian enterprise has the right to provide services of the Iridium system in Russia, in a number of CIS countries and in the Baltics. But the main way in which the Space Center imeni Khrunichev is to participate in the program's realization will be to manufacture its own Proton heavy launch vehicle for insertion of 21 communication satellites into orbit, and it will provide for their launching. The first launching is planned for 1997.

Russia: Lucid's Mir Stay Welcomed

964D0688C Moscow IZVESTIYA in Russian 22 Mar 96 p 3

[Article by Major Starus: "Men Await American 'Lady of the House' by Mir Station Fireside"]

[FBIS Translated Text] **The American Atlantis reusable spacecraft is waiting for good weather on Earth. This will be the third visit by the American Shuttle to the Mir Russian space station within less than a year in rehearsals for creation and operation of an international orbiting station.**

After docking with Mir and a few days of a joint visit in space with the station's crew, American astronauts will return to Earth, less one colleague. Doctor Shannon Lucid will remain aboard Mir, where she will spend 5 months in the warm company of Russian cosmonauts Yuriy Onufriyenko and Yuriy Usachov. I was told at the press service of Kennedy Center that the "two Uras" are waiting impatiently for Shannon. As it turns out, this anticipation certainly carries an element of self-interest. The Russian cosmonauts are hoping that "a woman's hands will finally restore some order in the station, which strongly needs the comforts of home."

In the United States where feminism has gained gigantic momentum, such housekeeping in space hasn't evoked any special enthusiasm. American feminists reminded the "two Uras" that Shannon Lucid is not a housewife but a biochemist with considerable experience in space. She has four flights behind her back.

The Atlantis crew consists of six persons. Its commander is American Air Force Colonel Kevin Chilton [transliteration]. Shannon is not the only woman on the crew.

The Atlantis odyssey will go on for 9 days. For 5 of them it will be docked with Mir. The crews of the two spacecraft will conduct a number of experiments and tests necessary for assembly of the new international space station being created jointly with the U.S., Russia, Japan, Canada and the European Space Agency. Atlantis is delivering new scientific gear and a few "household" goods to Mir.

Another four American astronauts will follow Shannon Lucid to the station prior to spring 1998. Each will replace another. Shannon will return home aboard the same Atlantis spacecraft, which will "pick her up" in August. On the eve of the launching, Shannon stated that the main difficulty she will encounter aboard Mir is not the sexual but the language barrier. Nonetheless she is certain that she will find a common language with the "two Uras."

Russia: Zhukovskiy Second-Generation Supersonic Project Described

964D0690A Moscow IZVESTIYA in Russian 16 Mar 96 p 1

[Article by Viktor Belikov: "The Legend of Our Aviation Returns to the Sky"]

[FBIS Translated Text] **Practical creation of 21st century transportation—a second-generation supersonic passenger airplane (SPS-2)—will begin on 17 March at Moscow's Zhukovskiy Airport. The efforts of "the big eight"—the world's leading industrial countries and their largest aerospace companies—are being joined to carry out the far-reaching project. In particular, Russia and the U.S. are jointly starting a 6-month program of testing and experiments in the Tu-144LL, a modified flying laboratory and one of the series of airplanes built in the 1970s and designed by the A. N. Tupolev Design Office.**

Next Sunday will be a holiday for Russian aviators and airplane designers. In the morning the huge doors of the hangar serving as the flight testing and development base of the Tupolev Design Office will part. A powerful tractor will strain as it cautiously begins moving, towing a 120-tonne sharp-beaked winged giant, with a new coat of blinding white paint, onto the wide expanses of the runway.

Specialists of many occupations, skilled workers of the highest qualifications who refer to themselves simply as "technicians," will gather together into a tight mass of humanity as they follow their offspring, born to fly over two and a half times the speed of sound.

A. Larin, a veteran of the firm and a division director at the special design office, reminisces:

"I became acquainted with this amazing airplane a little more than 30 years ago, and I have devoted an entire decade of my life to it. I can say without exaggeration that the entire collective of our firm, which numbers in the many thousands, was sincerely in love with the Tu-144, more so than with any of the other hundred and a half aircraft designed under the leadership of Andrey Nikolayevich Tupolev. In 1968, at the concluding stage of final development, two almost ready 'articles' came together in this same hangar—the supersonic 144-ya and the Tu-154 mainliner."

It was impossible to handle production of the two airplanes simultaneously, and so our leader settled without vacillation upon the supersonic airplane, which embodied many fundamental innovations—from titanium alloys and the forward horizontal tail surfaces to the unique landing gear design. "The supersonic airplane

couldn't be spliced together out of existing parts," said Andrey Nikolayevich, who never left the Tu-144 literally for days at a time as it underwent its birth before his eyes. For this time even the general designer's desk was moved to the hangar. Readers of IZVESTIYA learned the details of the first flight of the Tu-144 on 31 December 1968 from an excellent report by our essayist A. Agranovskiy.

The general designer's guardianship over the first supersonic airliner ended with his death in 1972. Next year our demonstration Tu-144, piloted by M. Kozlov's crew, met with disaster before the eyes of thousands of spectators at the Le Bourget Air Show. Chief pilot E. Yelyan was barred from flying prior to this for a reason of convenience—his divorce. The cause of the demise of the plane and the pilots has still not been determined, but witnesses to the tragedy told me later on in Le Bourget that the aircraft broke apart as it made an extremely tight turn away from a French Mirage fighter that suddenly appeared beside it.

Today's birthday girl—the aircraft bearing plant number 82—has long awaited her hour, having been forced into idleness on an airfield parking apron after 2 years of scheduled flights on the Moscow-Alma-Ata route. Relatively recently it was rested on an elevating mechanism, and its hydraulic system was pressurized in the presence of a group of experts from the U.S. The landing gear and other machine units began working right away without a hitch. The American "specs," who were well versed in engineering, were delighted by the demonstration of our equipment's reliability, which makes it possible to gain considerable time and save substantial resources in designing the SPS-2.

V. Klimov, the general director of the Tupolev Design Office, had this to say:

"Russia has unique experience in designing supersonic aircraft and in engineering their production, which is what attracted our partners to this project—NASA and companies well known to the world of aviation—Boeing, Rockwell, McDonnell-Douglas, Pratt-Whitney, General Electric, IBP Aircraft. Western experts estimate the demand for supersonic second-generation airliners at 500-1,200 airships by as early as the first 20 years of the 21st century. Creating such an armada would be possible only by uniting the efforts of all industrially developed countries.

"Our contribution, besides participating in pure scientific research and in the planning of the SPS-2, is significant and concrete. The modified Tu-144—the flying laboratory—is essentially a new airplane on which modern NK-32 engines used on the Tu-180 strategic bomber are installed. The entire aircraft control system, its electronic "guts," and the radio communication and navigation equipment were replaced with improved models. Test pilots of the Tupolev firm—S. Borisov and B. Veremey—will take the seats in the pilot's cabin during the first roll-out from the hangar. In the past, they were the first to fly the Tu-160.

A program of 32 experiments is to be completed in half a year of flight and ground tests—from recording the characteristics of the new air intakes of the engines, to measuring the temperature to which surfaces heat up, somewhere around 2,000 degrees. By the way, associates of Boeing's scientific and technical center, who have already been working in Moscow for 4 years, will join their Russian colleagues in processing the data obtained in the course of these tests."

According to the director of the Tupolev firm an experimental model of the Tu-244 could be built as early as in the year 2000—all of the necessary design groundwork is present for this. As for the cost of shaping the designs into metal, it will be close to $500 billion. No one country can manage such an amount, and so the advent of the SPS-2 may be the first international project of the next century.

Characteristics of Two Generations of Airplanes

	Tu-144	Tu-244
Length	64.45 m	83.7 m
Wing span	28 m	57.77 m
Height	12.5 m	16.25 m
Takeoff weight	207 t	350 t
Cruising speed	2100-2300 km/hr	2300-2500 km/hr

	Tu-144	Tu-244
Flying altitude	16-18 km	19 km
Range	6500 km	9200 km
Passengers	140	300

Russia: Space Cooperation With Americans Benefits Both Countries

964D0690B Moscow ROSSIYSKAYA GAZETA in Russian 21 Mar 96 p 4

[Article by Aleksandr Sharov: "Through the Thorns to the Stars"]

[FBIS Translated Text] **Foreign specialists call the Zenit launch complex the highest scientific and technical accomplishment of the 20th century in rocket and space engineering.**

I came into this world after Yuriy Gagarin's spaceflight. I lived all of my subsequent conscious life with the firm belief that however things go elsewhere, in space we would always be first in all respects. And to be sure, I wasn't far from the truth. Our country did in fact hold the lead for many long years in the study and development of space. Even initiation of the American Space Shuttle reusable spacecraft program didn't shake my convictions.

However, subsequent events were highly "sobering." Together with collapse of the space infrastructure of the former Union, we began yielding our positions in the development of stellar space step by step.

This was hardest of all on the people who worked for space. They didn't call strikes, and they didn't take to the streets with signs, but the elite of Russian science found itself in an extremely grave position. What was happening during these dreadful times at the supersecret enterprises of rocket and space industry? How many brilliant minds has the country lost? We will never know. But it is a consolation that the age-old desire of mankind to reach the stars continues to excite our minds, and materialize in certain practical ways in new launchings, research and development. Yes, Russia is behind today in the pace of development of space, but as in the past, we are ahead of the entire planet in our plans!

I was reminded of this one more time by an order of the Government of the Russian Federation dated 8 February 1996 regarding participation of the Design Office of Transport Machine Building in a program to create (modernize) launch pads for American space rockets, and regarding delivery of ground equipment by this same design office to the U.S. for preparation and execution of commercial launchings of American delivery vehicles. An amazing and totally unusual event. Have the Americans, who are so jealous about everything having to do with their space programs, suddenly opted for cooperation with the Russian design office? On the other hand, could it be that the supersecret sector of the Russian economy is really opening the door to the inner sanctum for potential competitors and, God forbid, possible adversaries? This fact did of course evoke a great deal of gossip and misunderstanding, which motivated me to return to this document.

But let me begin with a little background. The Design Office of Transport Machine Building, which until recently was not known to every specialist in this field, was established in 1948 to design ground equipment for missile complexes for different armed services. In 1964 the KBTM [Design Office of Special Machine Building] became the head design office for creation of complexes of ground equipment for preparation and execution of launchings of space delivery vehicles. Development, creation and operation of launch complexes for the Kosmos, Tsiklon and Zenit delivery vehicles became the principal landmarks in the creative biography of the KBTM. Over 900 light and medium-weight delivery vehicles were launched from launch complexes created by the KBTM, to include the launching of 28 Interkosmos satellites. Today the KBTM is working on a launch complex for the new Russian Svobodnyy Cosmodrome near Blagoveshchensk, and on the plans for a general-purpose launch complex for space rockets of all classes in Plesetsk. In this case the latter is something totally new in world practice. And if everything goes as it should, Russia will be the first country possessing such a complex.

"In 1988 our firm was given the possibility for participating in international activity," said Academician Gennadiy Biryukov, KBTM's chief designer. "The Main Space Administration committed the design office to an Australian project to create an international spaceport on Cape York. Our specialists drew up the sketches for the launch complex. But because of financial difficulties this idea was never implemented."

The first foreign project to really happen was reconstruction of the launch complex at the Indian Shar [transliteration] test range, used to launch GSLV [Geosyn-

chronous Satellite Launch Vehicle] rockets carrying a Russian cryogenic block.

In 1993 we were approached by America's General Dynamics with a proposal for talks on writing a research paper on the possibilities for improving the launch procedures and launch equipment of the Atlas delivery vehicle at the Cape Canaveral test range. In June 1995 the KBTM completed its work under this contract. The Americans were advised to make certain changes in the procedure for assembling and installing the Atlas delivery vehicle on the launch pad, and to modernize the pad itself, the transporter, and the devices connecting ground service lines to the delivery vehicle.

The KBTM is now working together with the Energiya RKK on the "Sea Launch" international project, and with the State Space Scientific-Production Center imeni Khrunichev on the "Rokot" commercial project.

Our small amount of foreign economic experience showed that there is a niche that we could occupy in that North American market. But this is a very serious issue. Both we and the Americans need the government's permission for such activity. We have now been given the okay.

"What was it about the Russian side that interested the Americans?"

"Rocket technology is extremely dangerous. Accidents at launch pads are catastrophic as a rule. One of the most tragic examples was the death of Chief Marshal of Artillery Nedelin during one of the launchings in 1960.

"This is why our design office traditionally devoted, and continues to devote, special attention in developing its launch complexes to work safety during preparation and launching of delivery vehicles. The main resource for attaining this goal is automation of the production process of preparing and launching delivery vehicles. The KBTM proceeded slowly but surely with its developments, and it is continuing on this path."

The Kosmos launch complex designed in the 1960s was already 70-percent automated. The next step was Tsiklon, the level of automation of which reached 80 percent. And finally, manual labor is completely excluded from the Zenit launch complex. From the moment the rocket is delivered to the launcher and until it takes off for space, not a single person is near the starting point. All operations are controlled and monitored from a control station, at the same time that there is an enormous number of manual operations at the launch pad with the American Atlas.

Moreover the Zenit launch complex contains absolutely no unreusable articles—that is, ones that burn up as the rocket is launched, and repair of the launcher is not required. Another missile could be sent into space just 5 hours after a launching. In the meantime it takes many days of repair and restoration at the launch site after every launching of the Atlas!

Thus we can boldly say that the Zenit launch complex is the best in the world today.

Of course, the Americans couldn't have passed this up. They are perpetually seeking ways to increase the economic effectiveness of their space rocket complexes. Yes, the cost of creating an automated complex is 15-20 percent greater, but the operating outlays could be reduced by 30-40 percent. It would be sufficient to say that commercial launching using the Atlas delivery vehicle is approximately twice as expensive as using the Zenit.

Such that as soon as the opportunity arose, the Americans approached us. By our estimates, first off we could reduce the time it takes to prepare the Atlas for launching, and thus allow one extra commercial launching a year. And we'll see what can be accomplished after that. They are thinking over the next step in our relations.

"But isn't this just ordinary exploitation of our brains? And what does this do for the state?"

"Of course, from an economic standpoint the results are still small, and for the moment our experience is being exploited. But we are also learning to work under the conditions of stiff competition, and absorbing useful things. In contrast to the Russians, the Americans have real programs for modernizing old launch vehicles, and creating new ones. Participation in these projects by our specialists will doubtless bring benefits to Russia in the future, when the opportunity for doing the same thing will appear in our country."

As for keeping certain secrets, everything here is in order as well. Both the Americans and we are extremely careful in how much information we give out. And anyway, our rockets differ so much from theirs in design and in launch preparations that not a single bolt, not a single washer can be transferred from one article to the other. What we have here is creation of a new joint product.

And in general, despite the fact that we were shut off from one another for decades, we nonetheless traveled parallel courses. This path has led both of us to approximately the same place. We're astounded that even the day-to-day terminology used at the cosmodromes is similar. We could understand them without difficulty. Consequently the rapprochement of our countries in development of space won't do anyone any harm. We are fellow Earthlings, and we have the same interests. The

project to create the Alpha international space station, and the "Sea Launch" project, which is based on American satellites, our launch complex, a Ukrainian rocket and a Norwegian vessel, show us that you can't do without world integration in space research.

And as for Russia, I am certain that in 2 or 3 years we will fully restore our potential. It is impossible for the wisdom and energy of our people not to triumph. And then we will once again travel as before on parallel courses toward the stars, although now I would wish to believe that we will do so hand in hand.

Russia: International Cooperation May Save Space Industry

964D0839A Moscow NEZAVISIMAYA GAZETA in Russian 12 Apr 96 pp 1-2

[Article by Dmitriy Payson: "The USSR Was the First in Space, But Russia Still Has to Find its Place in World Space Travel"]

[FBIS Translated Text] Today is a holiday. Yuriy Gagarin, a citizen of the USSR, was the first in the world to fly into space 35 years ago. Five days ago, a Russian "Proton" rocket put the American "Astra-1D" commercial communications satellite into orbit, the first one designated for a commercial launch by the presidents of the two countries.

The past decades covered an era. Through the efforts of Russia's rocket builders we became "faster, higher, and stronger." By the mid-1980's, we had launched about 100 satellites each year and came close to creating a continuously operating piloted orbital station, which was realized at the beginning of the 1990's, in many respects by inertia, and we were praised for our rockets throughout the world. Meanwhile, our American friends had landed 12 astronauts on the Moon and put the reusable "Space Shuttle" system into operation. In the time remaining we continuously threatened each other with all kinds of orbital bombs, lasers, interceptor satellites, orbiting intelligence gathering outposts, and other nice things.

Furthermore, we became accustomed to space. We are not carrying reports on new launches on the front pages of newspapers. The fact that space travel had become a sector of the "national economy" of the USSR was mentioned at the CPSU congresses. At the same time, no one thought that any "-nautics" or any "-navigation," in Russian terms, could be a sector of the economy. Render to God what is God's and to Caesar what is Caesar's: only the applied results of space activity are subject to economic development. However, it may also be the opposite: the growing number of applied requirements dictate the need for development of the means to analyze new approaches and technologies. It is another matter that the military and priority tasks that have predominated in long-range planning thus far basically set the condition of an "ultimatum" approach: "The task should be performed on time." All kinds of costs and profitability were taken into account in the form of restrictions at best. The transition from such approaches to real "economic operation" in space activity is extremely complicated. Our rapidly deteriorating space program is rapidly getting rid of ballast at the very first opportunity. And what kind of ballast is there? In the 10 years from 1985 to 1995, the number of launches of Russian spacecraft decreased by nearly one-half as many, not to mention the deplorable financing.

And as long as we are speaking about financing, let us return to international cooperation. With a rare exception, there is nowhere to obtain more money today.

Unquestionably, there has been a departure from confrontation. Moreover, Russian firms with their economical booster rockets and extensive experience in long-term orbital flights—Valeriy Polyakov's record is a year and a half—joined surprisingly well in a new paradigm of the American space agency, NASA. Deprived as we have been of the latest requirements to put all kinds of "peacemaking appeals" and "asymmetric responses" in orbit, the Americans grew quite a bit "leaner" in money, and NASA Administrator (Goldin) thought up a new "mantra": "More efficient, less expensive, and faster." And after a while, effusive journalists reworded it "the invocation of Dan (Goldin)"—apparently it is now being turned into "More efficiently and faster, with Russia..."

Today about half of Russia's space budget is provided with American money received within the framework of programs to create the international space station "Alpha" and "Shuttle-Mir." Three or four years ago the heads of the Russian Space Agency and the "Energiya" Corporation walked through NASA's corridors with the idea of a joint station, and they were thought to be not in their right minds, according to an admission by Yuriy Koptev, the general director of the RKA [Russian Space Agency]. Our people turned out to be very normal at that time; collaboration was begun and very quickly reached the stage of "frontier posts." "There will be a striped post like this on the border between the two parts of the station—our side and the Americans' side," said project workers from "Energiya."

But the work did not stop in this stage. The project began to develop in accordance with natural laws. Today the Russian firms are building strictly our own "Alpha" segment as well as the central part of the entire station in general—the functional-cargo unit in a building slip

at the Khrunichev Plant. The Americans are paying the Khrunichev Center as they would pay Boeing and McDonnell Douglas, and, as it turned out, it is impossible to receive the money and think of the frontier posts. Recently the first occupants of the station, who will be sent there in the "Soyuz" in 1998, were named. Our Anatoliy Solovyev and Sergey Krikalev will be joined by Bill Shefford [transliteration]. But it is unclear thus far who will "command the parade" on board: not Solovyev—"until they have arrived," and not (Shefford). It is another matter that the Russian government will not allocate its share of the financing over the next month or two—as if we had been "deducted" from the project altogether.

However, it appears that it is getting closer to the time for serious discussions. The point is that the tasks of the survival of the sector and individual enterprises and satellite groups, the realization of target-oriented tasks, acquisition of the money and entry into the world market are often contradictory. In any case, the emphasis should be on compromises. On the other hand, an accumulation of contradictions is a true sign that the paradigm will soon be replaced. What we need is to say it this way, to put it in the most general terms, to understand our place in the world.

Last Monday a Russian rocket put an American commercial satellite into orbit. The "Astra" was installed on the booster with the help of a Swedish adapter; the Swedes purchased the explosive charges in France. The world is not divided into "us" and "everyone else"; the triple combination of "USSR/Russia-United States-Others" is gradually losing its meaning. Understanding of this, in my view, is the key to awareness of the role and place of our country in world space travel.

Just like the role and place of scientific-production giants in the commercial markets—the markets for launches and the markets for satellite systems. While Russia's "head firm" for space communications—the Krasnoyarsk NPO [scientific production association] PM—is pulled back and forth by state programs, using poor-quality domestic electronics, to put it mildly, practically all the other firms are attempting to add their own research and development for the state.

Not only for the state, however. One of the most highly promising projects is the "Yamal" satellite communications system, which is being built at "Energiya" for "Gazprom." The attempt being made to relinquish the domestic component base is most interesting: the basic "contents" of the satellites were ordered from the American company Loral Space Systems.

Some details of the contract were made public at the beginning of this year, and nearly finished satellites are already standing in the "Energiya" shops. And what about the communications equipment?..

Some details compel us to doubt: perhaps the strategists are right, protecting the obsolete domestic microcircuits to the end—at least to perform "strategic" tasks. On the other hand, strategy is strategy, but experience must be gained. We have almost the world's best booster rockets and satellite service systems, including electric rocket engines, and considerable experience in integrating systems in spacecraft—we would have found our place in the world division of labor. In the final analysis, the Japanese began with a screwdriver! It means that our "firms" should have people capable not only of creating world-class "iron," but of bringing it to the consumer, skillfully maneuvering in the launch market, looking for ways to install really first-class equipment in the satellites. But as if to make an evil prophecy: in the countries of Southeast Asia, they are already coming close to "yellow assembly" satellites—do you think they will not do this? Won't our market be filled up in 2 or 3 years by ones ready for launching—"pay and fly" by Hundais or Toshibas? And what will "Gazprom" and other potential customers who are not burdened by concerns for the people in Krasnoyarsk and Samara decide to do then?

Russia: Khrunichev-Lockheed Cooperation

964D0849A Moscow SEGODNYA in Russian 16 Apr 96 p 11

[Article by Konstantin Sorokin and Nikolay Averkov: "Cosmonautics Earning Too Little: Commercial Launch Income of GKNPTs imeni Khrunichev Comparable to Budget Appropriations to Space"]

[FBIS Translated Text] It has already become a tradition at all press conferences devoted to space to state what percent of the approved budget of the particular enterprise, and of the Russian Space Agency itself, its director was able to "hack out," "scrape out," "squeeze out" and "beg." Eloquent words promising that cosmonautics would be fully self-supporting, spoken in the late 1980s, turned out to be absolute nonsense. A sector existing as a conglomerate of experimental production operations and scientific institutes cannot recoup itself.

In all the world, the only real profit is in launching the delivery vehicles of commercial spacecraft, and in manufacturing and operating communication satellites. This is why such a boom is going on now in these directions. Data from navigation, weather and natural resource satellites are gradually beginning to enjoy demand, although the market for this information is

still very young. In the meantime all other directions of cosmonautics are unprofitable, at least for now.

Perhaps the State Space Scientific and Production Center imeni M.V. Khrunichev [GKNPTs] has taken the best path. It established its own joint venture with America's Lockheed-Martin—a giant of American aerospace industry—for commercial launchings of its Proton-K rocket. The GKNPTs is now manufacturing the rockets, and its foreign colleagues are handling the international marketing. The first such commercial launching, carried out by the Russian Aerospace Forces, occurred on 9 April at the Baykonur Cosmodrome. An Astra-1F geostationary television satellite designed by America's Hughes for the European community of satellite systems (SES) (Luxembourg) went into orbit with the help of a Russian Proton rocket. The cost of the launching (less insurance) was $60 million. The center is investing money earned from such commercial activity in development of its own production, and in reconstruction of the launching and technical complexes at Baykonur. This money is also being used to modernize the Proton.

If we agree that a paid launching of a rocket into space is a commercial launching, then practically all launchings of delivery vehicles in all of the world's countries fall under the definition of a "commercial launching." Perhaps only launchings of Soviet delivery vehicles manufactured at enterprises of the former Union Ministry of General Machine Building, using spacecraft of this ministry and following its plans, may be referred to as "unpaid" launchings. The ministry was in a sense "working for itself," and the word "commercial" was out of place. But launchings for other ministries (the Ministry of Defense for example) required interdepartmental settlements—that is, commercial operations. To date, only the People's Republic of China has such a system of "noncommercial launchings."

In all of the rest of the world, an order is placed for a launch vehicle with a manufacturing firm for every specific launching of a spacecraft. In this case the entity ordering the launch vehicle necessarily makes the appropriate payment for the vehicle, regardless of whether this is a state space agency, a military ministry or a private firm. This is also the way things should work now in Russia, under its own national space program. But things can also happen in another way. Cases are known in which delivery vehicles have been transferred from the arsenal of the RF Aerospace Forces for the needs of the Russian Space Agency.

People try to apply the term "commercial" in the narrowest sense to launchings of spacecraft belonging to private firms. But it is now becoming difficult to draw a line here as well. There have been cases where a spacecraft was designed with the money of a private firm, but under the program of a state space agency. And the reverse has occurred: delivery vehicles developed with the resources of state agencies have been transferred to a private firm for operation.

Income from commercial launchings by the GKNPTs has now come to almost equal the budget appropriations to cosmonautics, and it has essentially become one of the main sources of financing the Russian space effort. In addition the GKNPTs is participating in long-term Western projects. For example the Iridium mobile satellite communication system: the space center will launch some of the satellites for this system, and it has already established the Iridium-Eurasia joint venture together with the Zond-Svyaz Joint-Stock Company. This joint venture will build a tracking station handling 30,000 users of the Iridium system in the European part of Russia. The station will also provide the possibility of mobile communication to a number of other former republics of the USSR (Belarus, Kazakhstan, Georgia, Moldova, Uzbekistan, Estonia, Latvia and Lithuania). This firm will also create a distribution network for services of the Iridium system. A second tracking station is to be created in the future in Asiatic Russia.

Some of the problems of the rocket and space sector are associated not with financing but with structure and administration. An attempt to go over to the Western scheme—a state organization planning our civilian space activity and receiving a certain amount for this from the state—began with establishment of the Russian Space Agency in 1992. But given the situation faced by Russia today, this scheme didn't work. Some of the enterprises were able to go over to a fully independent life right away. But setting all of them adrift meant certain death by drowning. In addition to working on space problems, all Western firms necessarily do business in aviation, communications or some other high-tech production operations.

Its development having been halted in embryonic state, the Russian Space Agency is now but a parody of the USSR Ministry of General Machine Building. The Russian Space Agency manages 38 rocket and space enterprises, design offices and scientific research institutes, acting simultaneously as client and executor. There are of course a large number of big enterprises in the rocket and space sector that were not placed under the Russian Space Agency, and remain a part of the State Committee for Defense Industry—for example the GKNPTs imeni Khrunichev, the Energiya rocket and space complex, and the Polet Joint-Stock Company (Omsk).

[box]

In its almost 40-year history, Russian cosmonautics has become one of the leading science-intensive sectors, and its priority in many directions is recognized throughout the world. Manned flights, which are now celebrating their 36th anniversary, are the most brilliant direction of our cosmonautics. By the way, 19 April will be the 26th anniversary of orbital insertion of the first Zarya orbiting laboratory, called Salyut in the press. And this is the name of the station that took. Our country was also the first to test out military manned orbiting stations of the Almaz class (1973-1977). In 35 years Russian cosmonautics went from short expeditions aboard small craft to the enormous Mir manned orbiting complex, toward which the last module—Priroda—is to be launched on 26 April from Baykonur by a Proton delivery vehicle, carrying 2.5 tons of American scientific equipment. After Priroda docks with Mir, the orbiting complex's creation, which has been underway for over 10 years, will finally end. Advanced space technologies for producing rare alloys, perfected semiconductor crystals and ultrapure vaccines are being honed aboard the orbiting complex. This is precisely why foreign space agencies are showing such great interest in flights to the Mir space complex. The waiting list for flights isn't getting any shorter. Even the Americans, who are confident in their total superiority, will fly to our Mir prior to 1999.

Work on the Russian satellite communication system began in the mid-1980s. True, even now we are far behind the world leaders in this field. Owing to presence of telecommunication spacecraft, it has become possible to receive television programs and carry on long-distance telephone conversations throughout Russia's enormous territory and in countries of the near abroad.

Creation of a unified series of satellites based on the Vostok spacecraft was a major step forward. Its various modifications are being used to make a photo survey of the Earth's surface in order to permit observation of natural resources, they are being used to perfect various progressive space production procedures of the future, they are fulfilling biological research in orbit.

Russian fundamental space science has also had significant successes. Interplanetary stations have studied the Moon, Venus, Mars, and small bodies of the Solar System. Automatic laboratories have studied the Sun and its influence on natural processes on Earth. [end of box]

Russia: Yeltsin Voices Support for Space Program

964D0919A Moscow KRASNAYA ZVEZDA in Russian 27 Apr 96 p 3

[Report by Sergey Knyazkov: "The President Assures Us That Space Programs Will Have State Support"]

[FBIS Translated Text] We associate April not only with a bright sun which inspires hope of regenerated nature, but Gagarin's smile beckoning us to the stars. Indeed, April is also the holiday for space flight, the triumph of human intellect and audacious dreams. And for those who receive decorations from the president these days, this event is especially memorable. After all, it is marked by the 35th anniversary of the day that an envoy of the people of Earth went into orbit for the first time. And we are proud that he was a Russian.

The honorary title of Hero of the Russian Federation was awarded recently to those who returned from space expeditions: pilot-cosmonauts lieutenant colonels Vladimir Dezhurov and Yuriy Gidzenko, spaceship commanders, and pilot-cosmonaut Nikolay Budarin, flight engineer. The order "For services to the Motherland," Third Grade, was awarded to pilot-cosmonaut Colonel Anatoliy Solovyev and pilot-cosmonauts Gennadiy Strekalov and Sergey Avdeyev, flight engineers. U.S. astronaut Norman Thagard and European Space Agency cosmonaut and FRG citizen Thomas Reuter [transliteration], who took part in the joint flights, were awarded Orders of Friendship. Pilot-cosmonaut and Twice Hero of the Soviet Union, Major General of Aviation Vladimir Dzhanibekov, who is now training cosmonauts, was awarded the same order.

It is gratifying that Yuriy Koptev, general director of the Russian Space Agency; Gennadiy Anshakov, first deputy chief and general designer of the TsSKB [Central Specialized Design Bureau]; his deputy Georgiy Fomin; and Colonel General German Titov, the "Second Cosmonaut of the Planet," became holders of the order "For services to the Motherland," Third Grade, for their services to the state in expanding international cooperation in space research, the use of space for peaceful purposes, and for the development of new types of special equipment.

Orders "For services to the Motherland," Fourth Grade, were awarded to Lieutenant General of Aviation Petr Klimuk, chief of the Cosmonaut Training Center imeni Yu.A. Gagarin; his deputy, Maj. Gen. Avn Yuriy Glazkov; Oleg Bobkov, deputy general designer of the "Energiya" Space Rocket Corporation imeni S.P. Korolev; Aleksey Borisenko, director of this corporation's machinebuilding plant; and others.

Russian President Boris Yeltsin expressed confidence that guided by efficient use of its space potential, Russia will speed up formation of a modern market economy and will be able to provide a proper standard of living for Russians. He also stressed that the state is doing everything possible to maintain the scientific and technical, production, and personnel foundation for domestic space operations and it is creating the most favorable conditions for the development of rocket and space technologies and fulfillment of Russia's international commitments.

Boris Yeltsin also said it is gratifying that enterprises in our space sector are looking for and finding ways to become part of the new economic system themselves, and they are making use of market opportunities and economic freedom to the maximum extent possible. In this connection, he voiced his satisfaction about what he had seen at the Khimki enterprise "Energomash" NPO [Scientific Production Association]. After all, thanks to the work of its specialists in several areas, we are outstripping our American partner-competitors for a minimum of 10 years.

A strict schedule for financing the federal space program this year was adopted in the government decree that was approved. For the first time in recent years! An additional trillion rubles is being drawn into the space sector. In addition, Boris Yeltsin's edict on establishment of the "Progress" State Rocket and Space Scientific-Production Center in Samara was signed on 12 April. The government was also instructed to develop a mechanism to provide overall state support for projects aimed at moving high-tech output, including in the field of space and rockets, into the world market. The principal space products for export will be exempted from duties under the president's edict.

In conclusion, Boris Yeltsin told the recipients of decorations:

"You are the people of heroic exploits, honor, faith, and a clear objective. May you always be accompanied by success!"

Russia: Khrunichev Center's General Designer Interviewed

964D0919B Moscow KRASNAYA ZVEZDA in Russian 27 Apr 96 p 5

[Article by Anatoliy Nedayvod, director and general designer of the GKNPTs [State Space Scientific-Production Center] imeni M.V. Khrunichev: "Science and Production Are Inseparable in the GKNPTs imeni M.V. Khrunichev"]

[FBIS Translated Text] ***One of the April issues of the newspaper MOSKOVSKIYE NOVOSTI carried an article entitled "Orbital Stations: A Road to Nowhere," which touches upon activity by the State Space Scientific-Production Center imeni M.V. Khrunichev, in particular, and contains the statement that activity by the once powerful and first-class "Salyut" KB [Design Bureau] under the GKNPTs has been completely neglected.***

For a number of years lately, KRASNAYA ZVEZDA has been following the activity of the center, which has been able to maintain and increase its scientific and technical potential under the difficult conditions of a market economy. We asked Professor Anatoliy Nedayvod, deputy general director and general designer of the GKNPTs imeni M.V. Khrunichev, Honored Scientist of the Russian Federation, and full member of the Academy of Cosmonautics imeni Tsiolkovskiy, to comment on the MOSKOVSKIYE NOVOSTI article. Here is what he said.

The newspaper's statement absolutely does not reflect the actual state of affairs at the Space Center, which is a rare exception—if not the only exception—in our former military-industrial complex, most of whose enterprises were forced to curtail their scientific and specialized activity.

Everything developed in the "Salyut" KB since its formation in 1951, beginning with the unique aircraft of V.M. Myasishchev to the "Proton" and the military rockets and heavy spaceships and stations, including the "Mir," was realized on a high technological level at the Khrunichev plant, one of the country's oldest aviation enterprises. Establishment of the State Space Center not only made it possible to smoothly unify all stages of the life cycle of advanced, highly complicated rocket and space complexes from research work to analysis of the fields of application, justification of requirements and the first axial line on a sketch to their development, production, and operation, but determined its new quality and scope at the level of the world's largest aerospace associations.

Commercial orders for the "Proton" rocket now make up about 50 percent of all orders; under the conditions of repeated cutbacks in state financing, this enables the center not only to maintain its high scientific and technical potential, production, and social infrastructure, but to expand them by extending and deepening scientific research work to develop promising new rocket and space systems, as well as to provide work for about 100 subcontracting enterprises, keeping 84,000 jobs for them.

The Center imeni M.V. Khrunichev has developed the "Rokot" light booster, based on the SS-19 intercontinental ballistic missile being taken from military duty, and it is also attracting growing attention in the international market.

The "DM" booster unit, a development of the "Energiya" RKK [Rocket and Space Corporation] imeni S.P. Korolev, is being used now on the "Proton" rocket. However, the requirements being forecast exceed its current power. For this reason, work is under way at the Khrunichev Center to develop more powerful and fundamentally new booster units: the "Briz-M" (based on the third stage of the "Rokot") and a multipurpose oxygen-hydrogen booster unit (KVRB) which can also be used on the newly developed Russian and foreign boosters ("Angara," "Ariane-5," "Titan-4," and others).

Our center is also finishing the development of a cryogenic booster unit for the Indian GSLV [Geosynchronous Satellite Launch Vehicle] booster rocket. Its flight tests will begin in 1997.

The geopolitical situation that has taken shape is forcing our country to create a new space rocket complex. This is for the new-generation "Angara" booster to be based at the "Plesetsk" and "Svobodnyy" cosmodromes, which has greater lifting capacity than the "Proton."

Another principal direction of the center's work is the development and creation of a family of spacecraft, stations, and modules in the 20-metric-ton class: the transport ships "Kosmos"-929, 1267, 1443, and 1886, the "Salyut" series of orbital stations, and the base unit of the "Mir" station and all its modules. Creation of the multipurpose functional cargo unit (FGB) should be mentioned in particular; it was initially intended for use as a transport ship to supply the "Almaz" orbital complex, created under the leadership of Academician V.N. Chelomey. The FGB forms the basis not only for the aforementioned "Kosmos" craft and all the modules of the "Mir" station, but for the power unit of the International Space Station "Alpha"; its assembly will be begun with the launch of a "Proton" booster in November 1997. This unit is being created under contract with NASA on a commercial basis.

Studies are under way at the Khrunichev Center on a system for ecological monitoring of the Earth's surface and atmosphere and a survey of natural resources, as well as operational monitoring of emergency situations (forest fires in particular). I want to emphasize that each of the rocket and space complexes named is a step in the climb to a new scientific and technical level for the center. Their creation is preceded by many years of planning and research work. In the process of searching for the best possible solution, up to 100 (sometimes even more) configuration and design alternatives and layouts are studied, and as a rule, upgraded (but realistic) requirements are developed for the structural materials, technology, engines, and systems of the rocket and space complex being created. This broad-scale and thorough scientific work is performed mainly by the collective of the center's design bureau, together with head institutes in the sector and a number of specialized enterprises.

The existing and predicted volume of these operations and payment for them guarantee not only retention of the highly-skilled collective and the return of some associates who left previously, but the planned influx of young employees.

Russia: RF Law on Kazakhstan Baykonur Cooperation

964D0919C Moscow ROSSIYSKAYA GAZETA in Russian 25 Apr 96 p 6

[Text of Federal Law "On Ratification of the Agreement Between the Russian Federation and the Republic of Kazakhstan on Cooperation and Interaction in Providing Security for the 'Baykonur' Complex, Military Elements of the Russian Federation Located Temporarily in the Territory of the Republic of Kazakhstan and Persons Who Are Part of Them," adopted by the State Duma on 5 April 1996 and approved by the Federation Council on 10 April 1996]

[FBIS Translated Text] The Agreement between the Russian Federation and the Republic of Kazakhstan on cooperation and interaction in providing security for the "Baykonur" complex, military elements of the Russian Federation located temporarily in the territory of the Republic of Kazakhstan, and persons who are part of them, signed in the city of Moscow on 29 December 1994, is ratified.

[Signed] President of the Russian Federation B. Yeltsin

Moscow, the Kremlin
20 April 1996
No. 35-FZ

Russia: American Shuttle Development Analyzed

964D0844A Moscow NEZAVISIMAYA GAZETA in Russian 12 Apr 96 p 6

[Article by Rudolf Mikhaylov: "It Is Time to Take Our Turn in Space"]

[FBIS Translated Text] **Our hearing has not been restored yet after the screech of propaganda about "the triumphal victory of socialism in space" (referring to the first flight by our Soviet "Buran" in**

automatic regime at the end of 1989), since here in Russia, no one can positively indicate the location of the "grave" of the world's best rocket-spacecraft system, "Energiya-Buran," which is buried forever. But in distant America, meanwhile, the very significant 15th anniversary of "their space shuttle," our former antipode, arrived in time! About which we Russians had "forgotten" to say something convincing in our time. Today, on Space Flight Day, it would be interesting to compare how the "Space Shuttle" began in the United States and how the "Buran" ended in Russia.

It has been a long time since 1958. In the bowels of the Pentagon, one of the most secret space programs is beginning under the not very expressive name of "Dynamic Ascent and Planning." In a few days after approval of this document, its text, obtained by Soviet intelligence, appears on the desk of Chief Designer Vladimir Chelomey. After familiarizing himself with it and dreaming about taking part in the assault on space, the aviator rubs his hands: "If only we had someone to do battle with in the open, eh?"

It follows from the document that this refers to a spacecraft about 11 meters long, with a small delta wing, a flat lower surface, and twin vertical fins at the ends of the wing, tentatively called the "Dynosaur." A "Titan-3" rocket was selected for the booster. After it leaves space, the craft enters the atmosphere, begins dynamic rocket braking and gliding flight, making a horizontal landing.

The Americans' next stage in probing near space is the "Start" program, which involves spaceship technology and the completion of work before entry into the atmosphere. In a year, the work is completed with a fundamentally important result—the running-in of "lifting bodies," the prototypes of the future "Shuttle." By 1967, the United States is flight testing three versions of these bodies, each one with a cockpit in the nose. In April 1969, the program with reusable spacecraft acquires a real executor in the form of a NASA working group. It is significant that the "Shuttle" initially was developed as a multipurpose transport system, without a specific, target-oriented function in space; its main assignment was designated as "replacement of crews in orbit and material and technical support for space systems."

The enthusiasts at NASA start out in the new direction so vigorously that in August they lay out for management the first version of the design for the future "shuttle." The moment is considered so important at the strategic, long-term level that management decides to make discussion of it not departmental, but even international in nature! And experts from England, France, and the FRG fly from Europe to Washington in military aircraft and meet on 16 and 17 October under conditions of complete secrecy. The future spacecraft's configuration is chosen after animated discussions. They decide to provide it with a delta wing to provide the craft with greater stability upon leaving orbit. For maneuvering in the atmosphere, turbojet engines are installed in the rear of the airframe.

The design of the "Space Shuttle" system, including the spaceship ("Orbiter"), a pair of rocket boosters, and an expendable fuel tank, is finally completed on 5 January 1972. A preliminary date is soon set for the piloted orbital flight of the "shuttle"—March 1978.

In early spring 1974, the Soviet leadership finally reacted "adequately" to the events: in absolute secrecy the decision is made to create a reusable space transport system in the Soviet Union; the design is assigned to the prominent rocket scientist and academician Valentin Glushko, who will head this secret, uninitiated race for the next 10 years.

Meanwhile, at the Dryden Flight Test Center at Edwards Air Force Base, an important event takes place in February 1977: the "Enterprise" orbiter, attached to the Boeing 747 mother aircraft, takes off for the first time. After numerous flights, the craft is flown "piggyback" on the same mother aircraft to the Marshall Space Flight Center in the state of Alabama, where it is subjected to dynamic testing on a vibration bench for 8 months. At the same time, 35 candidates for the crews of future spaceships begin training; they were carefully selected from 8,000 applicants and included six women. At the height of the training, the "Enterprise" was flown on the Boeing 747 to its new launch site, the Kennedy Space Flight Center, on 10 April 1979.

On "International Workers Solidarity Day," 1 May 1979, at the height of the stagnation period in the Soviet Union, the "Enterprise," together with the solid fuel boosters and the external tank, is taken on a caterpillar platform from the assembly building. The total mass of the system is 5,000 metric tons; on the same day, it is moved to launchpad No. 39-A by a diesel-electric transporter weighing about 3,000 metric tons. The "shuttle" is arranged on the launchpad in a vertical position, ready for launch.

On 27 January 1981, NASA management announces the final date for the first piloted flight—10 April. Alas, 20 minutes before launching, there is a barely noticeable but potentially hazardous discrepancy of 40 milliseconds in control commands in the "shuttle's" onboard computer "cluster," and the launch is postponed. After

a day, which incidentally coincides with the anniversary of the world's first space flight by Yuriy Gagarin, the spaceship makes its first flight. This time NASA management is more open about the spaceship's tasks: maintenance of spacecraft in orbits; sending the ground results of experiments from spacecraft, as well as the satellites themselves "for their repair, modification, and repeated insertion"; conducting experiments in orbit in accordance with independent programs; and finally, insertion of "our own" payloads in orbits at an altitude of 200 to 250 kilometers.

At 0700 local time, the "Columbia," in view of several hundred thousand Americans, whose vehicles took up space for many miles around, smoothly lifts off the pad with a gross thrust of 3,000 metric tons developed by three liquid-sustainer rocket engines and two solid-fuel thrusters. After about 20 minutes of anticipation, a report is received from astronauts J. Young and R. Crippen in orbit that everything on board is OK.

There is mourning in the labyrinth of the Kremlin's buildings. Curators of the Soviet program for a reusable transport system are saying through clenched teeth: "It is too soon to rejoice! A landing is still ahead!"

On 14 April, the "Columbia" enters the atmosphere, covering a distance of a little over 8,000 kilometers since braking is begun; the spaceship rolls out on the 5-kilometer runway No. 23 located at the very center of the Rogers Dry Lake bed with the complex of official buildings at Edwards Air Force Base. The time elapsed from liftoff was 54 hours 22 minutes.

A wave of enthusiasm spreads over the territory of the United States from the Atlantic to the Pacific oceans. The next day the crew is met by representatives of the world's press, and in responding to numerous questions, they enthusiastically praise both the flight and the new space transport system.

Within the framework of "Shuttle" tests, there were three more experimental flights by "Columbia," then on 11 November 1982 another four astronauts were launched into space—V. Brandt, R. Obermayer, J. Allen, and U. Lenoir [transliteration]. After completion of this flight, NASA officially announced that the "Space Shuttle" reusable space transport system had been put into operation, with servicing by its four "shuttles."

Each one of the similar "shuttles" is an aircraft-type spacecraft 37 meters long with a 24-meter wingspan and a cargo bay 18.3 meters long and 4.6 meters wide, as well as a vertical stabilizer at the rear of the airframe. It is not a simple machine, of course: as an example, its heat shield includes more than 30,900 tiles made of quartz fiber; the structural elements subject to the most intense heat—the nose of the fuselage and the wing's leading edge—are protected even more reliably by tiles made of carbon and carbon plastic. The "shuttle" cockpit holds up to seven astronauts; they remain in orbit for up to 7 days, with a possible extension to 30 days. Their flights are made under comfortable conditions, without pressure suits.

But what about the "Buran?" Never mind!

In order to be convinced of this, it is enough to grasp what is written under the name "Buran" in the volume just published in Russia by developers of the Soviet "shuttle," which had a triumphant flight in automatic regime at the end of 1989. The author of this publication carefully studied each of the 736 pages of the "work" cited in search of an answer to a legitimate question about the fate of the Russian "shuttle." Alas, I did not find it. Just as I did not find any mention of the name of the calm head of development of the "Energiya-Buran" system, Academician Valentin Petrovich Glushko. Only once, at the very end, he appeared almost as a casual outside observer, speaking out for quicker development of the "Energiya," which has vanished without a trace today.

One more appropriate question may be asked: "How can we be there in space without the 'Buran,' and what shines for us without it?"

I heard the most honest answer the other day from a noted popularizer of space flight, Nikolay Varvarov, a retired Air Forces colonel: "Why is it 'what?' Take your place among those who want to fly into space on the next 'Shuttle!' Under the condition, of course, that you find the foreign exchange to pay for this privilege."

Russia: Rosvooruzheniye Evaluates Aircraft Industry

964D0687A Moscow DELOVOY MIR in Russian 23 Mar 96 p 3

[Article by correspondent Aleksandr Ignatov: "Aviation Market Likes Stability: Report From a Round Table of Experts at the Santiago Air Show That Never Really Happened"]

[FBIS Translated Text] **The U.S., which brought over a third of the 70 aircraft exhibited at the Ninth International Air and Space Show in Santiago, FIDAYe-96, set the tone for this show. Because there was no Russian equipment to be demonstrated, our experts could do nothing more than talk about it beside the photographs and mock-ups. Such is the reason for this attempt to bring together everything**

they said about the state of our aviation industry, this "roundtable" by correspondence.

[Valeriy Skvortsov, member of the Board of Directors of the Novosibirsk Aviation Production Association (NAPO)]

While in the past we delivered airplanes, now we sell them. These aren't different words, but different states of mind. Back then, we filled state orders, and we didn't have any headaches about where our products were selling, and how. What a certain businessman from the U.S. said was a revelation to me: "You can make anything you like—the hard part is selling it." Introducing a product to the market is in fact an extremely complex process. Airplanes and helicopters are not only expensive goods, but they also determine a country's level of technological development. Technological development is not only the object of struggle of individual firms; it also involves the interests of the state, and the conflicts often go interstate. Our advantages are strong designers and low prices. Our disadvantages lie in outdated engine building, design of avionics instruments, and the finishing touches on the product—the interiors and its outward appearance.

[Andrey Yefimov, deputy chief designer of the Rubin Naval Equipment Design Office]

Paradoxical as it may be, the USSR's disintegration was not a disaster to military technology. Having lost traditional suppliers in Ukraine, we found fan and hydraulic system producers an order of magnitude better than in the past on the other side of the Urals. The fact is that high secrecy, even within the military-industrial complex, kept us from knowing what was happening next door, not to mention learning about the accomplishments in other forms of armaments. Our new partners, who were working just like us, in aviation or space, had no idea that they could be needed by someone.

[Valeriy Skvortsov, NAPO]

Because our enterprise was always associated with Antonov's design office in Kiev, we established a joint venture with it, and it is helping us to surmount the difficulties arising between Russia and Ukraine. Nor, as far as I am aware, are there any problems between the aviation plant in Tashkent and Ilyushin's design office.

[Viktor Puzanov, first deputy general director, Moscow Aviation Production Association (MAPO-MIG)]

Seven major design offices evolved historically in the country—Yakovlev's, Myasishchev's, Beriyev's, Tupolev's, Ilyushin's, Sukhoy's, and Mikoyan-Gurevich's, not to mention Antonov's in Ukraine, and leaving helicopters aside. Each has its specialization, though there are elements of competition as well. Other countries have from one to three design offices of this sort, and no more. As for whether all of these are needed now, time will tell and the market and economics will decide. In my area of fighter aviation, in addition to MIG, Sukhoy is holding on. I think the rest won't survive.

[Boris Kuzyk, assistant to the RF president on military technical cooperation with foreign countries]

For us, the future lies in creation of financial-industrial groups bringing together developers and producers, which will make it possible to take a step toward transnational companies with the participation of firms of the near and far abroad. The first experiment is MAPO-MIG, where major French firms are participating in creation of the 21st century's training airplane—the MIG-AT, and which the producers of Kamov helicopters plan to join. Such integration will strengthen all parties, and the group as a whole, which would be fully comparable to North America's Boeing.

[Aleksandr Kotelkin, general director of Rosvooruzheniye]

Banks and insurance companies should work in financial-industrial groups, while the groups themselves should strive toward self-sufficiency, and plan their activities several years ahead. Our main criterion in creating the financial-industrial group is the interests of the country as a whole, and the advantage will be given to those who build products for export. But for the moment in cases where the production chain is idling—every airplane is associated with hundreds of enterprises throughout the entire country, which are all experiencing difficult times—we are signing contracts with those that can supply spare parts, modernize our articles, restore mothballed products if necessary, and so on. It was for these purposes that Rosvooruzheniye invested $406 million of its own resources in 1995.

[Aleksandr Pavlov, deputy general director of Aviaeksport]

Our country has outstanding aircraft and highly interesting plans, and they can certainly be called aircraft of the next century. Among them are the Ruslan, which is incomparable to the new cargo craft exhibited here from the U.S.—the C-17. There is the Mi-17, a helicopter offered at FIDAYe-96 by the plant in Kazan and the plant in Ulan-Ude, which sometimes compete with one another by the way. There is the MIG-AT, which can be used to learn how to "drive" just about any aircraft in the world. And the An-38 from NAPO, a typical "workhorse" able to take off from anywhere. But outdated

engine design causes many producers to seek engines abroad. However, I am convinced that even with Western engines and avionics, the Western market won't let us in. And in the meantime we are losing our market. Former socialist countries bought 60 percent of the aviation equipment we sold. But we are being displaced from there, and those same countries are also selling our airplanes at giveaway prices, taking the bread right out of our mouths. Don't forget that many military and civilian airplanes and helicopters for which uses cannot be found remain both in Russia and in the CIS. They are being sold on the foreign market at bargain prices.

[Mikhail Tikhonov, marketing service director, Kazan Helicopter Plant Joint-Stock Company]

The sale of our helicopters to commercial organizations abroad, which was especially active in 1992-1993, is a painful issue. They were bought cheap, even directly from the plants in rubles, and then resold for foreign currency—for not very much, but at an enormous profit. Here's an example: An Mi-26 wound up in Peru for $2.5 million, while the price on the world market is $10 million. Agreements, including with us, contain the promise not to export the aircraft. But by various devious means they were ferried abroad. They were unprepared, they had been sitting around for several months, and even years, and were sold without spare parts and service. As a result, Colombia, Peru and Vietnam have suffered disasters that damaged our brand name and trust in our enterprise.

[Aleksandr Pavlov, Aviaeksport]

We are troubled by internal debts and the money shortage, to include the problems of paying wages and growth of the prices of materials and component articles, which raises the price of an airplane to the world price, and makes its sale unprofitable. The most important issue is certifying the aircraft under world standards. In the past we didn't have any special need for this, counting on our friends in the marketplace and asserting that "ours is the best." World standards are now being embodied in new aircraft from the planning stage, though the plans have yet to be realized. However, this issue has not been resolved for models already released.

[Viktor Puzanov, MAPO-MIG]

Moreover the buyers of our equipment often lack the purchase money. That includes Aeroflot and the Ministry of Defense. On our part, we also need to think about how to help buyers find investors, establish banks, and so on. One thing is clear in all cases: without the state's participation and without its financial assistance, aviation cannot develop anywhere in the world.

[Sergey Vartanyants, acting general director, Aviazapchast Limited Joint-Stock Company]

We will not be able to enter the foreign market in a civilized manner without solving internal problems. Moreover, as long as we keep going to international shows like we did in Santiago this time—each in his own corner, without a pavilion, without a flag, competing with one another—in short, working unprofessionally and behind-the-times, we will not enjoy the attention, respect and results that the airplanes and helicopters we design deserve. It was pleasant to hear praise from the commander-in-chief of the Chilean air forces regarding "Soviet products," as he called them, and his delight with the "exceptional" craft—the Su-27, which he piloted at the FIDAYe-94. But exhibiting your equipment just once over a period of many years is no longer enough. Aviation likes stability, and the aviation market likes it twice as much.

Russia: Gagarin's Death Possibly From Cockpit Explosion

964D0751A Moscow NEZAVISIMAYA GAZETA in Russian 27 Mar 96 p 6

[Article by Mikhail Rudenko: "'He's Too Precious to Mankind for His Life to Be Risked': Yuriy Gagarin, the Planet's First Cosmonaut, Died on 27 March 1968"]

[FBIS Translated Text] **On that gray, frosty morning in the cloud-covered sky above the tiny provincial city of Kirzhach, an airplane plunged earthward with a top-class crew of two Heroes of the Soviet Union aboard.**

Dying before the eyes of several backwoods Russians, air force colonels Yuriy Gagarin and Vladimir Seregin didn't know at the last instant of their lives that they would be betrayed by those who shouted louder than all about their love for their people to the entire world for decades—the Kremlin camarilla, which never did anything to uncover the secret of the disaster.

The Kremlin. 1967. 15 March. The Soviet VPK [military-industrial complex] holds a secret conference on space. The meeting is chaired by Leonid Smirnov, the chairman of the USSR Council of Ministers State Committee for Defense Technology, and the ramrod of the defense establishment. At the end of the meeting he asks a few of his comrades responsible for manned cosmonautics to stay behind, and tells them confidentially of the opinion of the central committee and government, which decisively objected to the "feeble impulses by certain cosmonauts regarding their further participation in the development of space." First among the

"wave-makers" is Yuriy Gagarin, whose life "we certainly can't risk, as you understand, comrades."

General Nikolay Kamanin, the assistant to the air force commander-in-chief for space, explodes: "So why not make a museum exhibit out of our number one cosmonaut! Have you really decided to destroy him to the glee of the imperialists?! If that's so, then you should at least stay consistent to the end: bar him from playing sports, driving a car, walking!"

VPK chairman Leonid Smirnov reluctantly gives in: "His desire to add to the glory of the motherland is a noble one, and I personally haven't anything against it! But the Ministry of Defense has to make its opinion known too. And we'll prepare materials for the Politburo."

1968. 26 March. Merited military pilot of the USSR, Lieutenant General of Aviation Pushkin: "On hearing from Seregin by telephone that he was going to clear Gagarin for an independent sortie, I mentally approved the command's choice of instructor to accompany him: Volodya had fought in the war, he had 200 sorties aboard the Il-2 behind his back, he had shot down three Messerschmitts, and he had a total of 4,000 hours in the air. He graduated from the academy with an appointment to the Air Force Flight Research Institute. As a pilot he is reliable, cool, qualified, and disciplined to the highest."

27 March. 0800 Pilot-cosmonaut Andriyan Nikolayev: "We left the building together, and were walking in the direction of the gate. Suddenly Ura stopped:

"'Oh, darn!'

"'What's the matter?' we asked.

"'I forgot my airfield pass.'

"'So what? Everyone knows who you are.'

"'But it could cause some trouble.... No, I better go back....'"

1050. Colonel Aleksandr Maslennikhov: "Chasing down Kamanin at the Cosmonaut Training Center, I told him that Gagarin and Seregin had taken off at 1019 but communication with them was broken at 1032. At the close of our conversation I expressed concern that 'their fuel will run out in around 10 minutes'."

1300. Il-14s and helicopters comb the Kirzhach vicinity in fairly good visibility, but without results. Generals Nikolay Pushko and Nikolay Kuznetsov tactfully remind Kamanin: "Maybe it's time to report to the leadership?" "Too soon!" he cuts them off roughly.

Finally at around 1500 the long-awaited radio message from a helicopter. Major Valeriy Zamychkin reports: "I see pieces of a down airplane at a point 64 kilometers from Chkalovskiy and 3 kilometers from the village of Novoselovo!"

The first landing party steps out of the helicopter an hour later, about a kilometer from the airplane's crash site. Wallowing in the wet snow, the soldiers have a difficult time getting to the smoking crater, which is already rimmed by a crowd of local inhabitants, with technical specialists interspersed among them.

1840. By nightfall it becomes clear that the irreversible happened. None of the visiting flow of generals uttered Gagarin's name aloud as they stepped around the smoking crater, but the signs of his demise were more than sufficient: remnants of a flight jacket, footwear, a plotting board bearing notes made with a red felt-tip in his handwriting.

Finally, General Kamanin reaches a decision, and asks to be connected to the Air Force Main Staff. From there, a message soon travels to the Kremlin: "Seregin died, and it is very probable that Gagarin died, but a final conclusion will be made after a thorough survey of the disaster location."

28 March. 0145. Air force deputy commander-in-chief, Colonel General Pavel Kutakhov: "Assistants of the general secretary latched onto me with a death-grip, demanding 'hourly briefings on the results of the investigation.' All of my attempts to explain to these zealous civil servants that serious things aren't done this way were met with a total lack of understanding. I was well aware of all of the political consequences of the incident, and I was not about to give out any information without carefully double-checking every word and fact."

1000. A government commission with the task of "revealing the circumstances and causes of the death of Y. A. Gagarin and V. S. Seregin" is created by decision of the Central Committee. The membership of this "collegial body" could no' have been any more terrifying: Ustinov, Smirnov, Dementyev, Yakubovskiy, Vershinin, Mikoyan. This "powerful collective" is kept in line and cemented by a comrade from the "agencies"—General Nikolay Zakharov.

The first thing this highly authoritative body does is to immediately create, by the end of that same day, four entire subcommissions for the main strategic directions of the "meticulous inquiry." Among them, the fourth subcommission is distinguished by the seriousness and responsibility of its tasks: its purpose is to prepare the overall conclusion and report to the Central Committee. It is led by Smirnov—Ustinov's right hand. Of course, there aren't, and cannot be in this or in any of the other subcommissions, any outsiders: they are staffed only

with comrades from the KGB, the Central Committee and the government, being only slightly "diluted" by space pioneers.

The moment Leonid Smirnov is issuing his last instructions on organizational matters, leaders Leonid Brezhnev, Aleksey Kosygin, Nikolay Podgornyy and Dmitriy Ustinov are forming up in an honor guard at the Central Palace of the Soviet Army. Beside them are all of the cosmonauts and relatives of the decedents.

At 1030 the government makes the decision to cremate the decedents "on that very same day." This occurs at 2100 in the presence of all cosmonauts, Ustinov, Vershinin and Kamanin. At night the urns containing the remains of Gagarin and Seregin are delivered to the Red Banner Hall of the TsDSA [Central Palace of the Soviet Army], and from 9 o'clock on the following morning they are made available for viewing by laborers.

2240. A coded message arrives at the Air Force Main Staff from the airplane's crash site: "The airplane's engine and part of the front cockpit have been recovered; the aircraft clock, wristwatches of the pilots, and Gagarin's I.D. together with a photo of S. P. Korolev were found...." "Minor details" such as discovery of a snapshot of the decedent's spouse, Valentina Ivanovna, together with Korolev's photo are omitted by the telegram's writers in view of the "unimportance" of these facts.

29 March. By morning, the searchers find more than enough sufficiently material evidence of the death of the two-man crew. In the meantime the flow of people passing through the TsDSA continues without end.

At midday the funeral commission makes a decision to organize a memorial ceremony for the decedents in one of the unoccupied halls of the TsDSA. This mourning rite is attended by 200 persons, including 130 invited. Over the course of half an hour several thousand applications come in from the Central Committee, the Council of Ministers, the Supreme Soviet and the Ministry of Defense for participation of apparatchiki of all ranks and persuasions who, to the surprise of the organizers, have instantaneously developed a love for the deceased heroes. But the unending list of faithful bureaucrats is mercilessly cut to 70.

Returning home, General Kamanin makes an entry in his "underground" diary, for which the KGB is to search much later in vain on instructions from the Central Committee: "It was hard to listen to the long sad speeches. It was hardest of all for Valentina Ivanovna, but she held on with whatever strength she had left. Her gaze of indifference to all that was happening said but one thing: 'Ura is gone. I will never see him alive again....'"

4 April. Dmitriy Ustinov visits the Cosmonaut Training Center with an enormous entourage, in one of his usual unannounced forays. He acquaints himself thoroughly with the testing base, talks long with cosmonauts, returning again and again to Yuriy Gagarin's flight, and expressing disappointment: "Time is passing, and the causes of his death are still not established." He is angered most of all by the fact that "no one is able to offer even a hypothetical explanation of this incident": "What the hell is this? A hundred of the best are mucking about, but no one is able to say anything sensible!"

11 April. Nikolay Kamanin, diary entry: "I can't stop thinking about the most vital question being asked these days by thousands of Soviet people in their letters to the government: 'Why didn't you make sure that nothing would happen to Gagarin?'

"I know better than anyone else that safeguarding the lives of famous cosmonauts is one of the most important matters, one of my fundamental tasks. I've traveled all over the planet with him, he met with hundreds of millions of people, speaking up to 20 times a day. Everything went well.... He and I kept to the strictest regimen, and we managed to keep our performance and alertness high.

"Yuriy had a very strong character, but even a steel robot couldn't have withstood the onslaught to which he was subjected daily by ministers, marshals, academicians and other 'important people.' Everyone wanted to have a drink with him, and without fail, it was always 'bottoms up.' I submitted reports, plead, and insisted on limiting meetings of cosmonauts with the people. A Central Committee decree was even adopted, but there was no way to avert the unavoidably negative influence of the banquets and drinking parties upon Gagarin's character and countenance. Slowly but surely the fast life and drinking parties erased Gagarin's enchanting smile from his face.

"The only thing that could keep Gagarin's personality from disintegrating was to train him for a new spaceflight, and to allow him to fly airplanes."

5 June. As the flow of findings from the search area near Kirzhach transforms into a river, and then into a sluggish stream, and finally a barely visible trickle, the investigation of the causes of the disaster shifts to the formal plane of legal procedure. The cause of the incident remains unestablished; nonetheless, the staff of the Central Committee and the VPK begins polishing the wording of the official conclusion regarding the

event for the mass media in an atmosphere of total secrecy (and in secret from the general staff).

Pilot-cosmonaut Aleksey Leonov: "The riddle, the incomprehendable incident paralyzes the mind. It was dependably established, you see, that just a minute before his death, Gagarin was absolutely normal: his speech in recordings of his radio traffic with the command post is even and calm, and both pilots maintain a working posture right to the point of impact: Ura had his left hand on the control stick, and his feet were on the pedals, as were Seregin's."

26 July. A top secret draft of a decision "on the Gagarin disaster," born in the labyrinths of the staff of the Central Committee and the VPK, is laid on Leonid Smirnov's desk at the Council of Ministers. A statement is attached for approval: "The probable cause of the disaster is execution of a rough maneuver...followed by the airplane's assumption of supercritical flight parameters in adverse weather."

Rumors abound on this earth. Especially on Soviet earth.

Having heard of this, General Kamanin visits the VPK, crosses paths with Leonid Smirnov, and goes into a tirade on the spot: "What does 'rough maneuver' mean? Where did that come from?! And what is the meaning of this succession of incomprehensible 'or's', used by the authors solely to confuse the reader? Why say things like this?! Where did you dream up such nonsense?! What's the matter with you: Don't you see that this so-called 'statement' contradicts all of the facts and the actual flight situation? And besides everything else, that it soils the honor and merit of the decedents?!"

Checking with different offices of the headquarters of the defense complex, to his horror Kamanin discovers that generals Kutakhov, Pstygo, Mishuk and Yeremin had already surrendered to the staff without any resistance, and approved this wretched "rough maneuver"!

27 July. "Secret" news of this "conclusion" of the leadership, which has no basis in reality, finally reaches Zvezdnyy settlement; an unsanctioned rally takes shape spontaneously at the Cosmonaut Training Center. On the spot, Gagarin's comrades-in-arms take over the Red Nook, where they lock themselves in and sit down to write an "open letter" to the guardian of Soviet cosmonautics, Central Committee Secretary Dmitriy Ustinov: "Because the negative pressure difference in the cockpits of Gagarin's airplane could only have been the result of escaping pressure, all the reasons for it should have been studied. It could have happened as a result of damage to the canopies or cockpit resulting from collision with a foreign object (including an air balloon), or from an explosion in the airplane in the cockpit vicinity. We feel that there are no grounds for the conclusion that the airplane went supercritical, and that as a consequence its crash was due to a rough turn of the airplane by the pilots away from clouds or from an air balloon. As aviation specialists we are stunned by such an arbitrary, unjustified interpretation of the actions of the pilots...."

Sensing soon enough that controversy was going to start brewing around the work of the government commission at any time, General Kamanin reports the situation to Commander-in-Chief Konstantin Vershinin. As it turns out, the marshal of aviation is also thinking about the tragedy, and, moreover, he has managed to arrive at a fully definite opinion in his mind regarding what happened on 27 March. He feels that the airplane's collision with a weather balloon, which shattered the cockpit glazing, making the crew unable to perform, was the most probable cause of Gagarin's death.

Kamanin leaves his faithful friend, old comrade and mentor with a feeling of satisfaction. As always, the marshal understood the essence of the event correctly. Kamanin is in solid agreement with him, but he does not exclude the possibility that an explosion might also have occurred in the airplane cockpit.

2 August. The "final version" of the CPSU Central Committee's decision regarding the cause of the deaths of Gagarin and Seregin is coordinated with the Central Committee's Defense Division. This conclusion, which is to be signed by Brezhnev and Kosygin, but which is never made public, proclaims: "The most probable cause of death was a rough turn by the airplane with the goal of avoiding collision with a weather balloon; a less probable cause was turning of the airplane away from the upper margin of the clouds. As a result the airplane assumed a critical flight angle, adverse weather made control of the airplane difficult, and the crew perished."

Aleksey Leonov: "From time to time the rumors and false versions regarding the circumstances and causes of the death of Yuriy Gagarin die away, and then revive with new force. What can you do? Such is the price we have to pay for the absence of truthful information."

It is fully obvious at the same time that this "bottomless sea" of conjectures and pseudo-hypotheses regarding Yuriy Gagarin, a name that is sacred to all people on Earth, was provoked by a real conspiracy of silence by leaders in the Kremlin regarding the circumstances of his death, and their total, absolute helplessness, as manifested in the organization of the disaster's investigation.

Russia: Military Space Research Funding

*964D0858A Moscow SEGODNYA in Russian
8 Apr 96 p 9*

[Article by Mikhail Chernyshov: "Nonlaminar Space"]

[FBIS Translated Text] Fluids or gases, according to the laws of dynamics, may be moved in a single flow by separate layers. This is called laminar flow. But if the layers are moved when the velocity of the flow is increased, the movement becomes chaotic. Russian space activity cannot be defined as laminar. The two principal component "streams" in it—civilian and military—have always been intricately interwoven. Clearly, a battle of streams is not taking place for the sake of the process itself. The source of conflicts has been and continues to be the federal budget, or, more precisely, claims for maximum access to it. A remarkable divergence between departments is being observed here in selecting the means of struggle, not because the Russian Space Agency prefers openness because of its civilian ownership, but because the Military Space Forces have a professional propensity for secrets. The difference is probably dictated by the results produced by their activity.

While the statistically average Russian is capable of understanding something in all the stratagems involved in the development of civilian space activity, military space activity is a "black box" from which almost nothing is learned from the outside. This is seen best of all in specific examples. An interesting detail has attracted attention in reports on the events in Chechnya: Dudayev's fighters have had portable two-way radios and computerized navigation units which operate through satellite networks at their disposal. There has been no mention of the foreign origin of these wonders. And for some reason, none of the federal subunits have been able to boast about such things. But after all, the picture logically should be just the opposite: only Russia and the United States possess sufficiently advanced military satellite systems, including reconnaissance, communications, and other systems. Both we and the Americans should have organized mass production of "ground-based equipment" for combat linked by satellites.

But there is not only lack of information on details. Things that are even more amazing are going on in our military space activity. If we are to believe the statements made by generals who say we have "mountains" of intelligence satellite information and that it is exceptionally important for planning operations, where are these mountains and why doesn't even a small part of it reach the desks of those persons who are making decisions which obviously are not supported by specific data?

It has become fashionable to say that our military space activity has become absolutely open. The VKS [Military Space Forces] have been legally formed, even though it is "late." But there is essentially nothing more than the simple statement of the fact. Military specialists, primarily from the ranks of retirees, taking advantage of the fact that the secret classifications and "admittance" clips do not seem so terrible after all these years, willingly recall that there existed a military satellites administration within the Ministry of Defense as far back as the early 1960's; that together with the civilian "Salyut" orbiting stations, there were the military's "Almaz" stations, which were not like them at all; and that the Russian "Buran" reusable spaceships were created not only as a nonoffensive means of transportation, but as a "counterweight" to the flotilla of American "Shuttles," which are capable of inflicting irrevocable nuclear strikes against a potential enemy, among other things. Many other things may be learned about the past, but nothing actually specific about Russian military space activity today.

Grains of information are derived only from a comparison of official statements by the heads of civilian and military space activities, although a number of inconsistencies are revealed even here. Thus, from a recent statement by the general director of the Russian Space Agency, Yuriy Koptev (See SEGODNYA No. 62 of 12 April 1996), it follows that of the more than 150 Russian spacecraft in orbit, only roughly half of them are civilian satellites. The other spacecraft are military. But we cannot separate "the sheep from the goats," since the overwhelming majority of spacecraft have a dual purpose, that is, they are being used by both the civilian and military departments.

The fates of domestic piloted spacecraft encounter zigzags that are even more drastic. The first spaceships were built in the USSR in accordance with an order from military departments, and military pilots flew in them. In the 1970's, during the era of orbiting stations, a secret attempt was made to conduct work with the civilian "Salyuts" and the military "Almazes" at the same time. Deliberate confusion was created: out of seven "Salyuts," two stations were actually "Almazes." Special crews were trained for them—each with two military cosmonauts. According to the recollections of their contemporaries, they were ideally suited to space reconnaissance—"for example, a cosmonaut photographed a foreign airfield with the necessary magnification, and in a half hour the photograph was on the desk of the officer in command. No automatic satellite can compete with an individual in taking into account the conditions for a photograph—the cloud cover, the time of day, the angle of vision." But operation of the

military stations was discontinued. The third "Almaz," which had already been prepared for work in orbit, was not launched. Planning of the special transport spacecraft for the "Almaz" stations, which differed from the current "Soyuzes," was discontinued.

Piloted spacecraft, beginning with the last "Salyuts" and the "Mir," became entirely civilian, but in accordance with some incomprehensible tradition, the commander on these spacecraft (with only a few exceptions known) is still a person with shoulder straps. The cosmonaut training center today has a "unique dual status"—it operates for the needs of the RKA [Russian Space Agency] and the VKS. At the same time, certain leading domestic firms have the right to train "their own" cosmonauts.

The "partial demilitarization of space" undertaken during the union period, according to Koptev, is bringing an unexpected and somewhat extravagant "economy of funds" which enables domestic civilian space activity to make ends meet to a certain extent. In 1977 after long hesitation, the USSR began building the aforementioned flotilla of its own shuttles, similar in capabilities to the American "Shuttles." The decision was based on computations by specialists at the Keldysh Center and other institutions who maintained that otherwise the country would simply have no "counterarguments" in the coming "star wars" with the Americans. The undertaking led to the useless expenditure of 17 billion "old rubles." Anyway, the huge sum would have increased to a fantastic amount if the "Burans" had begun regular flights. This did not happen, fortunately. But because the Americans were unable to discontinue operation of the "Shuttles" in time, one-quarter of NASA's budget is still being spent on their flights each year; this is impractical, inasmuch as reusable spaceships are one-third as economical as disposable rockets.

The concept of survival professed by the RKA and based on the idea of open discussion of the space budget is constrained, all the same. The union's space activity managed without this. But now the RKA, more than the VKS, is oriented toward international cooperation. The managers of civilian space activity have more opportunities to exert pressure on the government by the threat of disruption, let us say, of projects such as "Interbol" and "Mars-96," and stopping research in the "Mir." We have always been rather afraid of international scandals. It is probably easier for the RKA to define itself with the "fleet" of needed domestic satellites. But the headaches are continuous here: thus far no one can say distinctly "our orbital group of 156 spacecraft"—is this good or bad? At one time, the best alternatives were considered, but the price of "being driven by a mathematical answer" in the example of all the "Burans" was very apparent.

For all that, the need for open discussion of the concepts of both civilian and military space activity is obvious. It is not worth making a tragedy of the fact that the experience of Duma debates in this area has produced nothing yet. Otherwise, we will always be haunted by questions without answers. For example, how the VKS, which are continuously complaining about the miserable budget, are contriving to maintain "military security of the state at the proper level," to build housing for themselves, and even to nurture plans for transferring Baykonur to the Far East.

As far as the last item is concerned, civilian and military specialists apparently will never come to an agreement on plans for forthcoming "major construction projects." According to the military, Svobodnyy will cost 50 billion rubles [R] in government subsidies in the first stage and R4.5 trillion in the second stage; it will mean 150,000 jobs for the Far East and optimistic prospects for the VKS, including foreign exchange earnings for launchings. But in the RKA's opinion, replacing Baykonur with Svobodnyy cannot be discussed at all. This concerns only consideration of the possibility of launching small satellites with the aid of rockets which have become unneeded from the territory of a former military unit. It would be unwise to discard the facility that exists. But we cannot say that Russia soon will have a new national space center without doing anything to resolve the economic and ecological problems and without establishing contact with our closest foreign neighbors. As a minimum, another 2 years is required for further study of the situation. In addition, the rapidly changing political situation, in particular the so-called "deepening of integration" between Russia and Kazakhstan, may bury the idea altogether. Many aspects of the development of military space activity would not have led to so many questions if the VKS had built relations with the press on a more loyal basis. But military space activity, the bureaucrats almost h, must be given only positive publicity, and even better—in the superlative degree. All other texts are termed "slander," "malicious fabrications," and "betrayal of the Motherland." The VKS press service sees nothing shameful in pushing through materials in "pocket editions" which contain only eulogies that are absolutely ungrounded. In general, the position is painfully familiar, but it is unlikely to be effective for the VKS.

Ukraine: Missile Silo Destruction in Kirovohrad Oblast Described

964D0615A Kiev DEMOKRATYCHNA UKRAYINA in Ukrainian 17 Feb 96 p 2

[Article by Irina Chemerys: "Silos (Missile) Are Being Destroyed — Cracks Are Spreading. And How Are Next-Door Neighbors Feeling Because of This?"]

[FBIS Translated Text] **As a rule, large events when a state's honor is at stake demand sacrifice. Sometimes the sacrifice is so insignificant it is even embarrassing to talk about it — because its scale cannot compare to the planetary importance of, say, nuclear disarmament of Ukraine.**

In the Kirovohrad oblast, farmers have no particular emotional problems using such concepts as "nuclear silo" and "military facility." For decades state secrets existed, peacefully and routinely, somewhere at a village outskirts or a couple miles away from it. Nobody knows if any militaristic moods have affected the formation of the population's "everyday-life psychology," which is now being tellingly alluded to by ministerial bureaucrats in their correspondence with Mykola Petrenko, people's deputy from the Golovanivskyy electoral district No. 230.

But what exactly is the people's deputy getting at?

In Mykola Petrenko's district there are about 15 missile silos which, according to inter-state agreements and the Ministry of Defense plans, must be eliminated.

"I conclude that, as far as the consequences are concerned, the elimination of these silos is equivalent to an earthquake," says the People's Deputy. "How will this turn out for the rayon residents?"

A reply came from the respected agency Mykola Petrenko had sent his inquiry to: "... during a conversation it was convincingly proven to Deputy Petrenko that the technology used in eliminating silo launchers is technogenically and environmentally safe". Of course, it is a typo, which the Deputy was informed about in a telephone conversation. Indeed, Petrenko is being persuaded that the technology is safe in all its parameters and that the population's complaints are nothing but a manifestation of ignoram "everyday-life psychology."

Late last year a missile silo was blown up in the Golovanivskyy rayon territory (see map) — they were testing blasting technology. Farmers of surrounding villages, Yemylivka and Nalyvayka, felt the consequences of the explosion — cracks appeared on housing walls and in basements, the water level in wells dropped considerably, while in some wells water disappeared completely. In response to these complaints, village councils' commissions undertook a house-by-house tour of affected streets. Everything that had been mentioned was confirmed. Later Verkhovna Rada Deputy Petrenko and head of the state administration of the rayon Zaporozhchuk investigated the buildings and wells in these settlements. Again, they ascertained this. They sent the oblast state administration a report under the "For office use only" heading. The problem, so to speak, is being investigated.

However I'll venture to note that the people will have to convince managers at various levels more than once that the damage to buildings and water disappearance are the result of blasting rather than some other technogenic or natural circumstances. Will the people live long enough to receive at least monetary compensation? Wouldn't you agree that not every family budget can find money to repair the dwelling or rebuild a well.

In the face of the global process of nuclear disarmament it will not be easy for an ordinary citizen with his or her everyday problems to meet with understanding in high-placed offices. I wouldn't want to dramatize the situation unnecessarily, but note that almost all of us, if we have not become victims, have at least felt wide steps of great ideas — whether it was nuclear power serving peaceful purposes, removal of non-promising villages, creation of man-made seas, or elimination of the nuclear threat to the world.

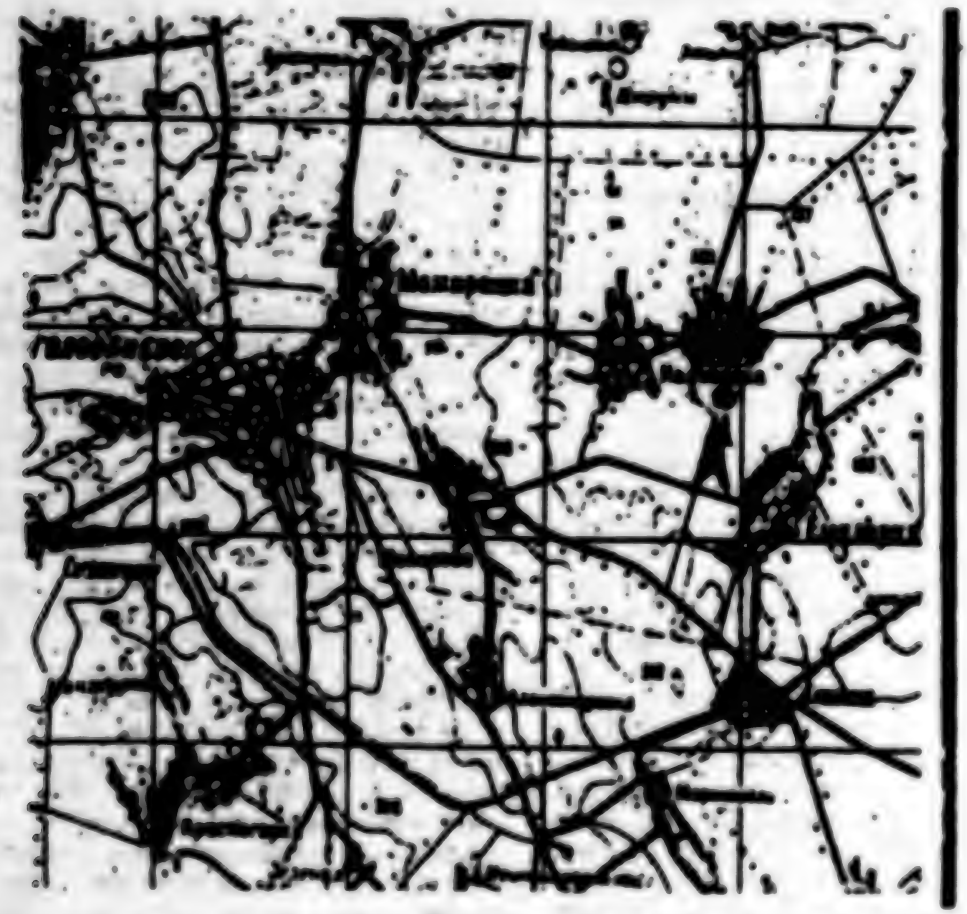
And another thing pricks one's ears: according to the plan, blasting will be conducted at other military facilities (silo launchers). While the above-mentioned villages are located within a 1-kilometer radius of the blasting site, there are settlements located much closer to the potential explosion site. Some village houses are located 200, 300, 500 meters from missile silos.

As Mykola Petrenko has found out, no one had investigated the effect of explosions on the hydrological situation in the area where silo launchers are to be blown up. Accordingly, no one predicted the disappearance of water or decreased water level in wells and therefore nobody knows whether it will come back, or whether the people must find a place for new wells.

At the time the State Committee of Ukraine for Geology and Utilization of Mineral Wealth experts petitioned, albeit unsuccessfully, Ministry of Environmental Protection and Nuclear Safety of Ukraine and were fighting for inclusion of environmental and geophysical studies into the work the ministry conducts according to the program of elimination of missile silos. According to an unofficial version, the geologists' initiative was perceived as the desire of the unemployed to create work for themselves. In the meantime, the geologists were warning that a number of silo launchers are located in the central

and southern regions of Ukraine where the top ground layer has higher sensitivity to shocks. Explosion elimination of silos, the majority of which are located in the upper zone of the geological environment, can activate dangerous geological processes, such as landslides, karst etc. According to the version Mykola Petrenko got from the geologists, it is not out of the question that water disappeared as a result of karst phenomena — the emergence of underground gaps, craters and cavities. This is what affected the level of underground water.

Of course each version needs an official confirmation. But it is the very absence of environmental examination in the silo elimination area, whereas there are documented facts of disturbance of normal people's activities, that calls for something more than wonderment.



The map shows the place where a silo launcher was blown up. Villages Yesaylivka and Nalyvayka are within a one-kilometer radius of the explosion, but the residents felt the consequences.

Russia: Reflection of Radio Waves by Multilayer Medium With Rough Boundaries and Inhomogeneities of Layer Permittivity

964D0423A Nizhniy Novgorod RADIOFIZIKA in Russian May 95 Vol 38 No 5, pp 422-435

[Article by S. F. Pimenov and M. A. Rudenko, Physics Scientific Research Institute at Rostov State University; (manuscript received 17 Mar 93); UDC 528.813:528.88.044]

[FBIS Summary] In an earlier number of this same journal (Vol 35, No 3-4, p 275, 1992) the authors examined the scattering of radio waves in a two-layer medium in the Kirchhoff approximation and derived analytic expressions for the coherent and incoherent components of reflected power with an arbitrary correlation between boundary irregularities. In this article the results presented earlier by the authors are theoretically gener-

alized for the case of scattering of radio waves in a multilayer medium with allowance for permittivity fluctuations in the layers (the correlation between large-scale boundary irregularities and layer inhomogeneities is considered). It was found that there are different mechanisms leading to an oscillating dependence of the incoherent component of reflected power P_{inc} on the return wavelength λ^{-1} and layer thicknesses. It also was found that with weak reflections the scattering fading effect for an n- layer medium having at least the order P_{inc}/P_{coh} is equal to about $(\sigma_n/\lambda)^{2n}$, where σ_n^2 is the dispersion of the irregularities of the upper boundary, P_{coh} is the coherent component of the reflected power. References 11: 10 Russian, 1 Western.

Russia: Radiation of Slot Antennas Through Nonlinear Plasma Layer

964D0423B Nizhniy Novgorod RADIOFIZIKA in Russian May 95 Vol 38 No 5, pp 436-443

[Article by M. V. Isakov and V. A. Permyakov, Moscow Power Institute; (manuscript received 8 Jun 93); UDC 621.396; 621.371]

[FBIS Summary] Nonlinear effects during the propagation of electromagnetic waves in plasma may be important near antennas radiating into plasma because a maximum intensity is attained precisely in near fields. However, only relatively simple models have been proposed for such cases. Research using plane models has shown that in the presence of strong nonlinearity it is necessary to take into account fields reflected within a nonlinear medium and accordingly a parabolic equation approximation, for example, becomes unacceptable. A single-mode waveguide approximation was proposed earlier for an analysis of antenna radiation, but such an approximation is restricted to the case of a quite thin nonlinear layer. In order to rectify such model inadequacies, in this article, on the basis of a numerical analysis, a study is made in a rigorous formulation of the radiation of slot antennas through a nonlinear layer when the thickness of the layer is on the order of the wavelength. Specifically, on the basis of a numerical solution of the nonlinear Helmholtz equation a study was made of the radiation of slot antennas excited by an H-wave through a plasma layer at an increased power level. The cases of positive and negative nonlinearities were analyzed. For negative nonlinearities a study was made of the effect of restriction of the transmitted power. For positive nonlinearities a study was made of formation of a self-sustaining waveguide channel. It is shown that bistability exists with a change in the power supply. The structure of the plasma near the antenna is analyzed for the case of a high level of radiated power. Figures 4; references: 8 Russian, 2 Western.

Russia: Asymptotics of Eigen Waves of Smooth-Irregular Spherical Anisotropic Waveguide

964D0423C Nizhniy Novgorod RADIOFIZIKA in Russian May 95 Vol 38 No 5, pp 457-466

[Article by V. V. Novikov and Yu. N. Solovyev, St. Petersburg State University; (manuscript received 15 Jul 93); UDC 538.566]

[FBIS Summary] In this article the results obtained in an earlier study (A. D. Avdeyev, et al., IZV. VUZov. RADIOFIZIKA, Vol 34, No 7, p 790, 1991) are generalized for the case of a spherical waveguide. The asymptotic form of the eigen waves in a smooth-irregular waveguide are found in the wave zone relative to the source and antipode, where $ka\theta >> 1$ and $ka(\pi - \theta) >> 1$, where k is the wave number in a vacuum, a is the Earth's radius, θ is the angular distance between the source and the observation point. As a result, in addition to the smoothness parameter characterizing the slowness of change in the properties of the waveguide in directions tangent to the Earth's surface, a second smallness parameter ctg $\theta/ka << 1$ appears. For that reason when writing the asymptotic form of solution of the Maxwell equation it is feasible to use a classical Debye series modified applicable to the horizontal rays and vertical modes method. In this study the asymptotic form is found in a form containing secular terms, in inverse powers of the wave number. As a simplifying assumption it is assumed that the waveguide is bounded by two ideally conducting spherical surfaces situated at the surface and in the ionosphere respectively below and above the regions important for the reflection of radio waves. Equations are derived for the horizontal eikonal and for the complex amplitudes of individual terms in the series. An approximate solution of the horizontal eikonal equation is found for a regular waveguide which can be used as an initial condition for definition of the eikonal in an irregular waveguide. References: 4 Russian.

Russia: Application of Harmonic Perturbations to Computation of Periodically Corrugated Waveguides

964D0423D Nizhniy Novgorod RADIOFIZIKA in Russian May 95 Vol 38 No 5, pp 467-480

[Article by S. Ye. Filchenkov and A. D. Yunakovskiy, Applied Physics Institute, Russian Academy of Sciences, Nizhniy Novgorod; (manuscript received 11 Jun 93); UDC 621.385.6+617.958]

[FBIS Summary] Hollow smoothly corrugated waveguides are widely used in powerful relativistic HF electronic instruments. They have high electric strength and

ensure effective interaction between an electron beam and a HF field. This article gives a solution of the problem of perturbation of the integral equation for axisymmetric waves of the electric type by perturbation of the waveguide profile. A solution is found for the problem of perturbation of an integral equation for axisymmetric waves of the electric type by perturbation of the waveguide profile. An analytic equation is written for the perturbed problem and an explicit form of the solution also is found for the case of a circular cylindrical waveguide. On its basis a solution is found for the inverse problem of retrieval of the waveguide profile from a stipulated dispersion dependence. Axisymmetric waves of the electric type propagating in a waveguide with ideally conducting walls are examined. The harmonic perturbation of an infinite axially symmetric periodically corrugated waveguide is used for the calculation of its electrodynamic characteristics. The analysis is based on the method of Fredholm-type equations of the second kind. The problem is solved analytically for a cylindrical waveguide. Characteristic results for appropriate checking are given in Tables 1 and 2. All pertinent computations were made with allowance for the first six harmonics. Twenty-eight values of the Floquet parameter were used in the checking. Table 3 gives the results for two specific circular waveguides. The table shows that in the retrieved profile there are no accumulations of harmonics, indicating an adequate regularity of the inverse problem. Figures 3; tables 3; references: 7 Russian.

Russia: Method for Determining Number of Uncorrelated LF Noise Sources in Nonlinear Two-Pole Networks

964D0423E Nizhniy Novgorod RADIOFIZIKA in Russian May 95 Vol 38 No 5, pp 481-490

[Article by V. M. Malyshev and V. G. Usychenko, St. Petersburg State Technical University; (manuscript received 21 Apr 93); UDC 621.372.44]

[FBIS Summary] There is now a need for noise models of instruments which would provide a physical validation and explanation of the dependence of the spectral intensity of current fluctuations on the imparted voltages. In developing such a noise model the principal problems pertain to sources of LF noise: how many there are, their geometric loci, the instrument parameters to which they are related and how the coefficients of their modulation effect on the current change with its variation in a wide range. Obtaining adequate answers requires experimental methods for determining the number of uncorrelated noise sources and their spectral characteristics. Several attempts (luminescent-correlation, SHF methods) have been made to resolve this problem, but they have had limited applicability. A new theoretical validation and method for practical application of the pulsed method for determining the number of reciprocally uncorrelated sources of LF noise in nonlinear instruments are therefore proposed. The basis for the method is measurement of the cross-correlation coefficient for fluctuations in the amplitude of two periodic series of current pulses with different amplitudes. A two-channel correlation device for measuring fluctuations of the amplitude of pulses was developed. Its block diagram is illustrated and is used in describing both instrument structure and functioning. The newly developed measuring instrument operates in both pulsed and continuous modes. The pulsed method is suitable for investigating other than two-pole networks. It also considerably broadens experimental capabilities. It can be used in studying the correlation between oscillation fluctuations and the noise of a quasistatic current. Experiments with pulses of different polarity may be useful. Figures 3; references 15: 12 Russian, 3 Western.

Russia: Image Slot Radiator as Exciter of Parabolic Reflector

964D0310A Nizhniy Novgorod RADIOFIZIKA in Russian Jul 95 Vol 38 No 7, pp 705-717

[Article by A. P. Volvach, G. I. Komar and V. P. Shestopalov, Radio Physics and Electronics Institute, Ukrainian Academy of Sciences; (manuscript received 12 Jan 94); UDC 621.396.677.71]

[FBIS Summary] A theoretical and experimental study was made of an image slot radiator (ISR) constructed on the basis of an image slot line (ISL) and a parabolic reflector coupled to an exciter in the form of an ISL-ISR hybrid module. Emphasis is on the linking of an ISR with the field of a parabolic reflector and optimization of the geometry of a reflector with an exciter. An experimental study was made of dish antenna (DA) with an ISR with an exciter in the millimeter wavelength range. The laboratory mockup consisted of an ISR and a parabolic reflector mounted on a single conducting substrate. The reflector was made of plastic with a layer of aluminum sprayed on in a vacuum. Analytic expressions are derived which make it possible to compute all the geometric parameters of the DA and the ISR linked to it. The experimental study revealed the applicability of the derived expressions for engineering computations of the DA parameters. The results will make it possible to link the hybrid modules operating in the millimeter range to the dishes and lenses of aperture antennas. The use of an ISR matrix as a DA exciter will make possible a considerable broadening of the possibility of the DA, a change in the architecture of an electronic unit based on an ISL-ISR, and as a

result a simplification of the feeder part of the device. In particular, depending on the specific design of the ISR matrix, in the DA it is possible to accomplish: a) decoupling of the reception and transmission modes, b) parallel reception at different angles and in different polarizations. Figures 6; references: 20 Russian.

Russia: Compensation Methods for Reducing Noise in Ultralow Frequency Range

964D0310B Nizhniy Novgorod RADIOFIZIKA in Russian Jul 95 Vol 38 No 7, pp 730-737

[Article by A. A. Gorbachev, V. D. Krasilnikov and Ya. G. Rodionov, Radio Physics Scientific Research Institute, Nizhniy Novgorod; (manuscript received 8 Dec 93); UDC 621.391.019.4]

[FBIS Summary] The ULF wavelength range is used in electronic research related to geoelectric reconnaissance and study of the Earth's electromagnetic field, but atmospheric and industrial noise constitute a great hindrance in this range. The noise level at the receiver inputs usually exceeds the strength of the useful signal and the noise itself has a non-Gaussian form. The nonlinear converters used for reducing pulsed interference are ineffective when the input mixture contains additional quasiharmonic noise. Under these conditions one of the ways to reduce noise is application of the compensation method. Noise compensation is a linear operation and in theory is unrelated to distortions in structure of the processed signal. In the reception of signals in the ULF range it is possible to use a zone-component compensation of noise based on subtraction of noise from different reception channels with allowance for the different dependence of the electric and magnetic fields on distance to the noise source. Zone-component compensation is effective in the suppression of noise from a single source. Under the influence of the totality of different kinds of noise this compensation ensures a limited gain in noise reduction — by an intensity factor of about 3. The compensation method in the ULF range is realized by relatively simple technical means. Its use makes it possible to increase the real response of a receiver. Figures 2; references 4: 3 Russian, 1 Western.

Russia: Optimum Estimation of Parameters of Nonstationary Random Pulse Sequence in Discrete Time

964D0310C Nizhniy Novgorod RADIOFIZIKA in Russian Jul 95 Vol 38 No 7, pp 678-694

[Article by A. M. Silayev, Nizhegorod State University; (manuscript received 24 Jan 94); UDC 621.391.01]

[FBIS Summary] The problem of optimum filtration of signals under the joint influence of pulsed and noise perturbations was solved earlier by the author and M. A. Maltsev. Proceeding on that basis, a study has now been made for optimum assessment of the parameters of a nonstationary flow of pulsed signals, received additively with noise, with allowance for a jumplike change in the mean repetition rate of the pulses. The theory developed earlier is applied for this purpose. In the formulation of the problem it is assumed that the amplitudes of the pulsed perturbations are statistically reciprocally dependent and for different i have identical a priori probability densities and the statistics of the moments of appearance of the pulses is not dependent on the amplitudes and is described by a scheme of nonstationary Bernoulli tests — the probability $\lambda(\tau, k)$ of appearance of the next pulse at the time k is not dependent on the times of appearance of the preceding pulses and experiences a jumplike change at the time τ: $\lambda(\tau, k) = \lambda_0$ when $k < \tau$, λ_1 when $k \geq \tau$, where λ_0 and λ_1 have the sense of the mean frequencies of appearance of pulsed perturbations before and after the jump time τ; λ_0, λ_1 are continuous random quantities for which a priori probability densities are stipulated; τ is a discrete random quantity. A recurrent algorithm for optimum assessment of the jump moment and the pulse repetition rate is written in current time. A solution of the problem of assessment of the parameters of an observed series of Bernoulli tests is given as an example. The results of an algorithm synthesized on an electronic computer are given. Figures 5; references 15: 14 Russian, 1 Western.

Russia: Nonstationary Electromagnetic Disturbances in Magnetically Active Plasma With Relaxing Conductivity

964D0310D Nizhniy Novgorod RADIOFIZIKA in Russian Jul 95 Vol 38 No 7, pp 668-677

[Article by Yu. K. Arkhipenko and V. N. Krasilnikov, St. Petersburg State University; (manuscript received 8 Dec 93); UDC 537.86]

[FBIS Summary] An approximate Green's function is found for the one-dimensional problem of disturbance of LF (10^{-1}-1.0) Hz electromagnetic fields in ionospheric plasma with uniform but nonstationary electric properties in the presence of gravitation and a horizontal geomagnetic field. A specific example of such a problem is the disturbance of fixed isothermic layers in the lower ionosphere due to their rapid heating caused by the local absorption of radiation incident from the outside. In addition to heating of the medium, external high-energy radiation usually causes the additional ionization of plasma, whose degree may greatly exceed the natural level, but relatively rapidly decreases due to recombination processes. The coefficients in the magnetohydrodynamic equations are dependent on time, which

substantially complicates the problem. However, under the condition that the speed of sound is much greater than the Alfven velocity, which holds true at altitudes less than 200 km, it is possible to construct an approximate solution for such nonstationary plasma. The proposed method makes it possible to assess the generated field without invoking the Fourier transforms approach and to give a clear physical interpretation of the results. The sought-for function is found on the assumption that the dynamics of the electromagnetic disturbance is determined by the diffusion mechanism. Acoustic wave movements serve as a source of the latter. It was found that real medium conductivity may lead to the appearance of an isolated precursor of a disturbance preceding the moment of arrival of the acoustic wave front. Figures 2; references: 5 Russian.

Russia: Study of Streams of Multi-Component Gas Mixtures in Partial Chemical Equilibrium Conditions

964D0686A Moscow IZVESTIYA ROSSIYSKOY AKADEMII NAUK MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan-Feb 96 pp 114-124

[Article by O. N. Suslov, Ye. I. Fateyeva; (manuscript received 13 Feb 95); UDC 533.6.011:541.1]

[FBIS Summary] The flow of a dissociated and partially ionized gas over blunt bodies is studied during a body's entry at hypersonic speeds into planetary atmospheres. The nonequilibrium character of gas phase chemical reactions is considered. Diffusion equations and corresponding transfer equations are derived for the case when a partial chemical equilibrium is established in a moving mixture of reactive gases. Navier-Stokes equations describing the motion of a viscous heat-conducting multi-component mixture are used in the absence of an external electromagnetic field. Only the diffusion-thermal part of the problem is considered and the equations are written in matrix form. A total of 33 specific chemical reactions are considered for an 11-component Earth air model. A 16-component model is used for Mars. Of the 33 reactions considered for Mars, 32 are the same as for Earth. Fast and slow reactions are differentiated. The assumption of a partial chemical equilibrium is applicable in the description of hypersonic flows over blunt bodies with a radius of approximately one meter during entry into the atmospheres of Earth and Mars in part of a planned descent trajectory. This approach can be used in a wide range of temperatures and pressures and greatly simplifies description of partial equilibrium flows of viscous heat-conducting multi-component gas mixtures. Figures 4; references 15: 13 Russian, 2 Western.

Russia: Comparison of Approximate Analytical and Numerical Solutions for Heat Fluxes in Supersonic Flow of Viscous Gas over Bodies

964D0686B Moscow IZVESTIYA ROSSIYSKOY AKADEMII NAUK MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan-Feb 96 pp 125-132

[Article by I. G. Brykina, V. I. Sakharov; (manuscript received 3 Nov 94); UDC 533.6.011.55:532.517.2]

[FBIS Summary] An axisymmetrical supersonic laminar flow of viscous ideal gas over blunt bodies is studied in a wide range of Reynolds and Mach numbers. An approximate analytical solution is obtained for the heat fluxes along the surface of the body relative to their value at the braking point. The expression for relative heat flux is dependent only on the geometry of the body and the pressure distribution along its surface. To evaluate the accuracy and the area of applicability of the formulas, they are compared with numerical solutions of complete Navier-Stokes equations obtained in the paper for bodies of various shapes (sphere, ellipsoid, paraboloid). At Reynolds numbers greater than 500 a good agreement of analytical and numerical results is obtained. As the Reynolds numbers increases the accuracy of the analytical solution improves. The greatest difference between analytical and numerical results is observed in the middle cross section of a sphere where heat fluxes are small. As the Reynolds number increases further, relative heat fluxes cease to depend on the Reynolds number, and the same can be said of the distribution of relative pressure. A figure shows the dependence of relative heat fluxes on Mach number, which is slight. Figures 5; references 6 (Russian).

Russia: Modeling of Turbulent Heat and Mass Exchange on Disintegrating Surfaces

964D0686C Moscow IZVESTIYA ROSSIYSKOY AKADEMII NAUK MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan-Feb 96 pp 133-142

[Article by D. S. Mikhatulin, Yu. V. Polezhayev; (manuscript received 2 Jun 94); UDC 533.6.011.6:629.78]

[FBIS Summary] Modeling of turbulent heat and mass exchange on a disintegrating surface in bodies in a high-speed flow was impossible with existing wind tunnel designs. A wind tunnel using chemical heating of the air stream was developed. Kerosene is burned in an oxygen-enriched atmosphere. Sometimes, this is replaced by a mixture of argon and oxygen for a clean-burning medium. The Mach number at the nozzle cut-off is about 2.1. A detailed description of the wind tunnel, one of the world's largest, is provided. In the experiment described here two types of model were tested, one of polymethyl methacrylate and one of a carbon-carbon composite. Near the critical point where the flow in the boundary layer is laminar, the surface of the model remains smooth. In the transition from laminar to turbulent mode the model becomes rough. Relief structures are formed on the surface due to flow instability in the boundary layer. In the area of turbulent flow the surface is again smooth. The depth and shape of the relief formations vary over the length of the body, and this is dependent on pressure and Mach number. Specific features of the destruction of the polymethyl methacrylate model related to thermal effects are noted. It is noted that one can model heat exchange and external combustion loss forms obtained when meteors and other bodies pass through the atmosphere. Figures 5; table 1; references 7: 6 Russian, 1 Western.

Russia: Effect of a Pressure Increase in a Powerful Explosion in a Medium Containing Fine Rarefied Channels

964D0686D Moscow IZVESTIYA ROSSIYSKOY AKADEMII NAUK MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan-Feb 96 pp 143-149

[Article by V. I. Artemyev, V. I. Bergelson, S. A. Medvedyuk, I. V. Nemchinov, T. I. Orlova, V. A. Rybakov, V. M. Khazins; (manuscript received 16 Dec 94); UDC 533.6.011.72]

[FBIS Summary] When shock waves interact with a thin heated surface layer a precursor wave arises in front of the shock wave front. For shock waves of strong to moderate intensity, the maximum pressure at control points on the surface is less than in the propagation of shock waves in an unperturbed medium. This paper uses estimates, numerical, and laboratory modeling to show that a completely opposite effect occurs in the close zone of an explosion in the strong shock waves stage. In the presence of a heated layer, the pressure at the control point may increase greatly. The propagation of shock waves in a bulk medium containing fine extended channels of material with a lower density may also lead to a significant change in the shape of the shock front and the flow after the shock wave. The effect, the thermal layer effect, was studied experimentally by creating the heated surface layer and the explosion with laser radiation. The surface was heated to 1000 K to a 1-1.5 mm thickness. The explosion was a laser pulse 100 ns in duration with an energy of about 20 J. The pressure at the control point was found to increase by a factor of 3-10. Figures 4; references 13: 10 Russian, 3 Western.

Russia: Grazing Boundary Conditions on a Catalytic Surface in a Multi-Component Gas Flow

964D0686E Moscow IZVESTIYA ROSSIYSKOY AKADEMII NAUK MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan-Feb 96 pp 159-168

[Article by B. A. Kiryukin, G. A. Tirskiy; (manuscript received 21 Jun 94); UDC 533.6.011.8:541.1]

[FBIS Summary] This paper presents a detailed derivation of the grazing boundary conditions of speed, temperature change, and concentration of components at a catalytically active surface in a flow of rarefied multi-component gas. The Maxwell approximation of flows method is used. The resulting boundary conditions are compared with previous findings (which were at times contradictory). The refined boundary conditions that are obtained can be used for complete or simplified Navier-Stokes equations for local Knudsen numbers Kn ≥ 0.3. References 16: 10 Russian, 6 Western.

Russia: A Simple Analytic Model of the Growth of Diamond Layers in a Reduced-Pressure Mixture of Methane and Hydrogen Gas by Using the Heated Filament Method

964D0609A Ivanovo KHIMIYA I KHIMICHESKAYA TEKHNOLOGIYA in Russian Vol 38 No 4, Apr-May 95 pp 45-51

[Article by Ye.P. Prokopyev, Materials Science Scientific Research Institute; manuscript received 7 Oct 93; UDC 621.315.592]

[FBIS Summary] Published experimental data support the conclusion that CH_3 radicals are most likely responsible for the growth of diamond layers by the method of using a heated filament in a mixture of methane and hydrogen gas at reduced pressures. On the basis of that conclusion, a simple analytic model of the growth of diamond layers by the heated filament method was proposed. A number of simplifications and assumptions were made when the model was developed. Specifically, it was assumed that the growth processes is limited by the diffusion and reaction of CH_3 radicals in the near-surface layer and on the surface of the substrate, whereas the reaction involving hydrogen occurs throughout the entire volume of the reaction vessel, including on the surface. Consequently, the graphite modification of carbon on the surface is suppressed very quickly under above-equilibrium conditions. In addition, the etching of the diamond layers by atomic hydrogen was ignored, and a rather idealized hydrodynamic model of the flow of the $CH_4 + H_2$ gas mixture near the critical point in the reaction space was used. The proposed model assumed a laminar flow of the gas mixture and is thus similar to the Landau-Lifshits model for the cylindrical coordinate system $r = (r, z)$ with its center in the position of the heated filament on the reactor's axis and the OZ axis directed to the fixed substrate. Landau-Lifshits basic hydrodynamics equations (continuity equations and Navier-Stokes equations) were used to derive a formula for the rate of growth [V_g] of the diamond layers on different substrates. The proposed formula makes it possible to analyze the dependence of V_g on key process variables and to obtain numerical growth rate estimates. A growth rate estimate obtained by using the proposed model was compared with results of experiments published in 1988. For the process conditions considered, the proposed formula yielded a growth rate of 1.27 μm/h versus the published growth rate of 0.5 μm/h. The inflated growth rate obtained by using the proposed formula was attributed to failure to consider the processes of surface etching by atomic hydrogen. It was emphasized, however, that on a qualitative level, the proposed model yields a satisfactory description of the experimentally obtained curves plotted for $V_g(h)$. References 31: 13 Russian, 18 Western.

Russia: Kinetics of Reactions Involving Technetium. XIII. Reduction of Tc(VII) by Oxyethylhydrazine

964D0617A St. Petersburg RADIOKHIMIYA in Russian Vol 37 No 5, Sep-Oct 95 pp 415-417

[Article by T.V. Gomonova and V.S. Koltunov, All-Russian Scientific Research Institute of Inorganic materials imeni Academician A.A. Bochvar, Moscow; manuscript received 23 Jun 93; UDC 546.718:546.799.4]

[FBIS Summary] Technetium in the form of purified technetic acid ($HTcO_4$) was reacted with 2-oxyethylhydrazine ($HOC_2H_4N_2H_3$) in a medium of hydrochloric acid. The reaction was conducted in the 1-cm optical dish of an SF-8 spectrophotometer. The experiment established that 2-oxyethylhydrazine reduces Tc(VII) to Tc(IV), with $TcCl_5^-$ ions (characterized by an absorption peak at 325 nm) forming in the process. The rate of the said reaction in HCl was determined to be described by the equation $-d[Tc(VII)]/dt = k[Tc(VII)][HOC_2H_4N_2H_4^+]^{0.5}[H^+]^{1.5}$, where $k = (8.75 +/- 0.46)10^3$ $l^3/mol^{3.5}$ min at 25°C and the ionic strength (μ) = 3.1. The reaction's mechanism was found to be similar to that of the reaction of Tc(VII) with unsubstituted hydrazine. Figures 2, table 1; references 7: 3 Russian, 4 Western.

Russia: Using the Sorption Method To Separate and Purify Strontium 90 From Solutions Generated When Reprocessing Nuclear Fuel. II. Obtaining Pure Strontium 90

964D0617B St. Petersburg RADIOKHIMIYA in Russian Vol 37 No 5, Sep-Oct 95 pp 470-474

[Article by S.P. Kudryavtseva, G.B. Maslova, and N.I. Polyakova, Physical Chemistry Institute, Russian Academy of Sciences, Moscow; manuscript received 20 Feb 95; UDC 543.544]

[FBIS Summary] In an ongoing study of use of the sorption method to extract and purify strontium 90 when reprocessing the fuel of VVER (water-moderated, water-cooled) nuclear reactors, scientists have proposed a new method of purifying concentrates of the strontium 90 obtained by using type VPK ampholyte at a cation exchanger in the presence of citric or chromotropic acid. Most of the calcium and corrosion products present in the strontium 90 are extracted by frontal chromatography on the KU-2 cation-exchange resin in the presence of Trilon B. When conducted under optimum conditions (a concentration of Trilon B of 0.1 mol/l, pH of 6-7, and use of KU-2 in Zn form), the process eliminates 95 percent of the calcium present in the strontium

90 and leaves no impurity cations in the concentrate. In tests conducted on samples in which the concentration of calcium was 20-25 times higher than the concentration of strontium, reprocessing the desorbate in five or more sorption cycles with VPK serving as the cation exchanger resulted in a strontium concentrate containing no more than 35 mg/Ci strontium 90. The strontium 90 obtained by the proposed frontal chromatography process may then be subjected to deep purification by the method of displacement chromatography. Ethylenediamine tetraacetic acid [EDTA] is used as the eluent, and KU-2 (60-90 mesh in H form) serves as the cation exchanger. The concentration of nitric acid in the starting solution must not exceed 0.2 mol/l, and a sorption rate between 2-3 ml/min/cm² is used. Under those conditions, all the alkali earth elements and impurities still present in the strontium 90 are completely desorbed on the semiconductor, provided that the capacity of the sorption layer is sufficient. The separation process is conducted in a series of columns (h = 20-40 cm) filled with KU-2 (60-90 mesh in Zn form) with a filtration rate of 3 ml/min/cm² and a temperature of 70°C. The ratio of separation and sorption layers is kept between 1 and 1.5. The length of the bands occupied by strontium in the final column must be significantly greater than the column's diameter. In tests of the process, the concentration of strontium in the eluent equaled 13.5 g/l, which corresponds to a strontium concentration of 1,200 Ci/l. Its chemical purity exceeded 99 percent, and its concentration of radiochemical impurities was less than 10^{-3} percent. The strontium is separated from the eluent by acidifying the solution to a pH of 1.8. After the H_4EDTA in the solution settles, nitric acid strontium remains. The proposed three-stage extraction method (sorption on VPK cation exchanger, frontal chromatography, displacement chromatography) may be used with other solutions encountered when nuclear fuel is reprocessed. Figures 5; references 4: 2 Russian, 2 Western.

Russia: Using the Sorption Method To Separate and Purify Strontium 90 From Solutions Generated When Reprocessing Nuclear Fuel. I. Extracting Strontium 90

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[Article by G.B. Maslova, S.P. Kudravtseva, V.M. Gelis, Ye.A. Kozlitin, and N.I. Polyakova, Physical Chemistry Institute, Russian Academy of Sciences, Moscow; manuscript received 20 Feb 95; UDC 543.544]

[FBIS Summary] A study examined the possibility of sorption extraction of strontium 90 from the raffinate left after nuclear fuel has been reprocessed. A procedure was proposed for selective extraction of strontium on the vinylpyridine ampholyte VPK in the presence of masking additives, either citric or chromotropic acid. The optimum process conditions were established by conducting a series of dynamic experiments in glass columns with sorbent layers 5 to 10 cm high and a filtration rate of 1 ml/min/cm². First, the relative stability of complexes of metals with the functional groups of the resin VPK was determined by potentiometric titration of VPK in its H form in the presence of various metals. The relative stability of complexes containing the eight metals studied was as follows: Cr > Eu > Ni > Al > Mn > Ca > Sr > Na. Next, the selectivity of VPK resin with respect to ions of alkali earth metals was examined. The following selectivity series was established when citric acid was present: Ca > Ni ≈ Mn > Eu > Al. The optimum conditions of the sorption of strontium on VPK were determined under dynamic conditions. In the presence of citric acid, VPK was found capable of absorbing strontium at a rate of approximately 4 mg-Eq/g when the Na form of VPK was used, the pH of the sorption solution was approximately 8.8, and the ratio of citric acid to strontium was 1 or less. When the ratio of citric acid to strontium was greater than 1, strontium was retained in the solution in the form of complexes. Analogous experiments performed in the presence of chromotropic acid established the the following as the optimum conditions for conducting the sorption process with chromotropic acid: use of the VPK resin in its Na form, maintaining a pH of 8, and having a citric acid:strontium ratio of 2:1 or less. Further experiments were conducted with solutions simulating the raffinate produced in the Purex process. ^{45}Ca was added to the solution as an indicator. The experiments established that in the presence of citric acid, the extraction process was most effective when the ratio of citric acid to the total amount of metal in the solution equaled 0.5:1 and the pH of the solution was between 7 and 9.5. When chromotropic acid was used, the process was most effective when the ratio of chromotropic acid to the total amount of metal in the solution equaled 1:1.8 and the pH was between 8 and 9.5. Under the said conditions, most of the impurities passed into the filtrate. The process was tested on an actual highly radioactive solution generated during reprocessing of the fuel elements of a VVER reactor. The starting solution contained the radionuclides ^{90}Sr-^{90}Y, ^{106}Ru-^{106}Rh, and ^{134,137}Cs and rare earth element radionuclides and had a concentration of strontium 90 of approximately 9 Ci/l. After citric acid had been added to the solution and its pH had been raised to 8, the solution was filtered through a column containing 0.5 m³ of the resin VPK in Na form. The desorption was performed with a 3 mol/l solution of HNO_3. The resultant strontium concentrate had a total strontium content of 138,000 Ci, degree

of concentration of 10, and yield of 98 percent. The proposed extraction process removed approximately 65 percent of the macroimpurities and 98 percent of the γ-active radionuclides from the solution. Figures 5, tables 2; references 4: 3 Russian, 1 Western.

Russia: Methodology for Determining Organic Impurities in Water

964D0630A Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 2, KHIMIYA in Russian Vol 36 No 5, Sep-Oct 95 pp 395-408

[Article by I.A. Revelskiy, I.V. Golovko, I.P. Yefimov, Yu.S. Yashin, B.I. Zirko, I.N. Glazkov, A.I. Revelskiy, P.P. Vulykh, and Yu.A. Zolotov, Analytical Chemistry Department; manuscript received 18 Oct 94; UDC 543.3:543.8]

[FBIS Summary] The pros and cons of using the following sampling and concentration methods to determine organic impurities in water were discussed: liquid extraction, sorption concentration, gas extraction followed by vapor-phase analysis, reverse osmosis, ultrafiltration, supercritical fluid extraction, and concentration in capillary tubes. It was concluded that the advantages of supercritical fluid extraction over liquid extraction increase as the concentration of compounds being determined decreases, largely because of the impurities contained in extractive reagents. Next, the detection limits of the various types of detectors used in gas chromatography and maximum permissible concentrations of common regulated impurities found in water were reviewed. On the basis of that analysis, it was concluded that most of the detectors used in gas chromatography have detection limits (10^{-10}-10^{-12} g) sufficient for making direct (i.e., with no need for preliminary concentration of the sample) determination of more than 99 percent of all currently regulated compounds, provided that the water samples analyzed have a volume of at least 100 μl. It was therefore recommended that water samples be analyzed by gas chromatography without preliminary concentration of the samples whenever possible. Several concentration techniques were recommended for use in those cases where concentration is necessary, i.e., when suspensions are present in the samples undergoing analysis and when the impurities that must be determined are present in concentrations below 10^{-6}-10^{-4} percent by volume. The first is based on concentrating impurities from large volumes of water (1 l or more) and using detectors with a detection limit of 10^{-10}-10^{-12} g and using microliquid extraction (volume of the extract, 0.2-0.5 ml) as opposed to the generally accepted technique and inserting the entire volume of extract into the capillary gas chromatograph. The second approach recommended is based on concentrating impurities from small volumes of water (up to 100 ml) and using detectors with a lower detection limit (10^{-10}-10^{-13} g) and microliquid extraction and again inserting the entire amount of extract into the chromatograph. It was further recommended that in cases of mixtures with complex compositions, the analytes be analyzed by two-dimensional gas chromatography or microliquid and gas chromatography or by using the said methods in conjunction with mass spectrometry. The most promising approach was said to be that of extracting microimpurities directly from water without using a solvent and polymer sorbents that could distort the analyte's composition. Such direct extraction could be done in one of several ways, including using the technique of supercritical fluid extraction to extract the impurities from aqueous solutions and transfer them directly to the capillary column (on-line) or by using an intermediate operation excluding the use of a solvent (off-line). Solid-phase extraction using sorbents permitting the separation of picogram quantities of different sorbates by thermal desorption without the use of organic solvents or thermal decomposition of the said sorbates during the separation process was said to be especially useful when separating and concentrating the most dangerous ecotoxicants and unknown compounds. References 123: 24 Russian, 99 Western.

Belarus: Properties of Semiconductor Sensors Based on Tin Dioxide Films Prepared by the Sol-Gel Method

964D0611A Moscow ZHURNAL ANALITICHESKOY KHIMII in Russian Nov 95 Vol 50 No 11, pp 1173-1177

[Article by D.R. Orlik, M.I. Ivanovskaya, and K.-D. Kol, Physicochemical Problems Scientific Research Institute, Belarus State University, Minsk, and Applied Physics Institute, Giessen University, Germany; manuscript received 11 Feb 94; UDC 543.274]

[FBIS Summary] A study examined the properties of tin dioxide-based thin-film sensors in which the gas-sensitive tin dioxide film was prepared by a sol-gel method according to which a stabilized sol of hydrated tin dioxide was subjected to thermal decomposition. The study focused on the characteristics of the sensors when they were used to detect CO, CH_x, H_2, and NO and on their ability to selectively determine individual gases in gas mixtures. The gas-sensitive film was prepared by applying a hydrated tin dioxide sol to a ceramic substrate measuring 3.5 x 2.5 mm with electrodes in the form of a platinum "ridge." The sensor was then dried by roasting in air at 800°C. The finished sensor measured 3.5 x 3.5 mm. The hydrated tin dioxide sol was prepared from $SnCl_4$. The sensor's gas sensitivity characteristics were measured in a flowthrough gas chamber as the

gas was passed through at a flow rate of 10 l/min. The sensor's resistance was measured in synthetic air and in a gas-air mixture with a stabilized voltage. The gas-air mixtures (Hoedst Gas AG) used had a relative moisture content of 50 percent. The sensors were demonstrated to be capable of determining the level of CH_4 in air within a wide range of concentrations, from 10 to 10,000 ppm. The sensors proved unstable when used to analyze methane-air mixtures with a high concentration of methane (10,000 ppm or higher) at relatively low working temperatures (185-335°C). At working temperatures of 410 to 560°C, the new sensors were capable of determining levels of CH_4 in air at concentrations to 1 percent by volume. The output signal of the tin dioxide-based sensors in response to CO were much lower than those in response to CH_4 given equal concentrations of the two gases in air. Adding palladium to the SnO_2 decreased the sensors' output signals in response to CH_4 while increasing their output signals in response to CO; however, the signals of the SnO_2-Pd sensors in response to CO still remained lower than those in response to CH_4 given equal concentrations of both gases. At working temperatures of 260-335°C, the SnO_2-Pd-based sensors only indicated the presence of CO, whereas at 410-560°C they responded to both CO and CH_4, thus pointing to the possibility of selective detection of CO and CH_4 by controlling the temperature conditions under which the SnO_2-Pd-based sensors are used. Just as when palladium was added to the tin dioxide, adding platinum to the SnO_2 decreased the sensors' response to CH_4 and increased their response to CO, H_2, and NO. The sensors were capable of detecting H_2 in concentrations as low as 10 ppm and NO in a concentration of 6 ppm. Further experiments confirmed that controlling the temperatures at which the SnO_2-based sensors are used makes it possible to selectively determine individual gases in gas-air mixtures of CO + CH_4 and CO + NO. Figures 2, tables 4; references 12: 2 Russian, 10 Western.

Russia: Determining the Level and Isotope Profile of Uranium in "Hot" Particles After the Accident at the Chernobyl Nuclear Power Plant

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[Article by A.Yu. Lyul and G.M. Kolesov, Geochemistry and Analytic Chemistry Institute imeni V.I. Vernadskiy, Russian Academy of Sciences, Moscow; manuscript received 3 Aug 94; UDC 543.53]

[FBIS Summary] Individual "hot" particles sampled from the soil near the Chernobyl Nuclear Power Plant were subjected to neutron-activation analysis to determine their isotope composition. GSR-1 and GSS-1 (with uranium concentrations of 18.8 and 6.3 μg/g, respectively) were used as standards for determining the study particles' levels of total uranium. The concentration of ^{235}U in each study particle was estimated by using aliquots of especially prepared titrated salts of solutions of natural uranium at levels of 10^{-3}-10^{-5} mg and levels of ^{235}U ranging from 10^{-5}-10^{-6} mg. The study particles and standards were packed in aluminum foil and irradiated for 20 hours in a flux of thermal neutrons of approximately 10^{13} n/cm²/s. The irradiated particles were transferred to pure aluminum packets to reduce their background activity and measured on an LP-4900 analyzer (Nokia) with a Ge(Li) detector with different cooling-down times (from 2 to 6 days). The resultant gamma-spectra were processed, and the concentrations of elements in each study sample were calculated by using the ASPRO program. Determination of the level of total uranium was based on ^{238}U (determined on the basis of ^{239}Np), and determination of the level of ^{235} was based on several radionuclides (^{131}I, ^{99}Mo, ^{95}Nb, compound103Ru, and ^{140}Ba) formed when the particles were irradiated in the reactor. The concentration of total uranium in the 12 "hot" particles analyzed was found to vary widely from 5.5 x 10^{-4} to 26.12 percent. Because they contained uranium in much higher concentrations than in the soil surrounding the Chernobyl Nuclear Power Plant (from 0.63 to 2.14 x 10^{-4} percent) and because of their isotope composition, the hot particles studied were concluded to contain dispersed nuclear fuel. A simplified but reasonably accurate and fast method for estimating the level of ^{235}U in nuclear fuel without using a standard was proposed on the basis of the relationship that was discovered between the ^{235}U content of the uranium contained in the hot particles and the ratio of induced radioactivity $^{239}Np(^{238}U)/^{99}Mo(^{235}U)$. The relationship was demonstrated to be reasonably correct when compared with the analysis results obtained for 10 of the 12 particles analyzed. Only two of the 12 particles analyzed contained ^{235}U in levels more than 20 percent higher than the value obtained by using the proposed relationship. Figures 2, tables 3; references 16: 15 Russian, 1 Western.

Russia: Dependence of Biospecific and Gas-Sensitive Sensors' Analytic Characteristics on the Type of Potentiometric Transducer Used in Them

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Vol 50 No 12, pp 1275-1279

[Article by Ye.B. Nikolskaya, O.V. Yagodina, and R.R. Iskanderov, Evolutionary Physiology and Biochemistry Institute imeni I.M. Sechenov, Russian Academy of

Sciences, St. Petersburg; manuscript received 14 Mar 91; UDC 543.257.1]

[FBIS Summary] A study examined the dependence of the analytic characteristics of biospecific and gas-sensitive sensors on the selection of the potentiometric transducer on which they are based. Gas-sensitive sensors were created by using the following types of potentiometric sensors: pH-metric electrodes with a glass spherical membrane and with a polyvinyl chloride membrane, solid-contact and ion-selective field-effect transistors with a pH-sensitive membrane based on Ta_2O_5, single-crystal Cu electrodes, solid-contact NO_3^--selective electrodes, and fluid-filled NO_3^--selective electrodes. Enzyme minianalyzers were produced that contained the following potentiometric sensors: pH-metric electrodes with a glass spherical membrane, solid-contact transistors with a glass flat membrane or polyvinyl chloride membrane and ion-selective field-effect transistors, and type EO-01 redoxmetric electrodes with a glass or polyvinyl chloride membrane. Biospecific minianalyzers were produced by clamping enzyme-containing membranes to a potentiometric sensor's surface. The role of the potentiometric sensor in gas-sensitive minianalyzers was evaluated by studying the following analytic characteristics of electrodes with a gas gap when they were used to detect NH_4^+ salts (NH_3) and NO_3^- ions (nitrogen oxides): response time, range of measurable concentrations of NH_4^+ salts, detection limit, electrode function slope, error in determining NH_3, and coefficient of methylamine's effect. Practically all of the said analytic characteristics depended on the type of potentiometric sensor on which the gas-sensitive minianalyzer was based. For example, response time varied significantly depending on the shape of the electrode's sensitive surface (electrodes with a spherical membrane had the best response time), and slope of the electrode function was determined by the reaction occurring on the electrode's surface. It was demonstrated that the optimum potentiometric sensor for a given gas-sensitive minianalyzer depends on the specific conditions under which that minianalyzer will be used. For example, a copper electrode was shown to result in a lower determination error when NH_4^+ (NH_3) salts were being detected. Microanalyzers based on an ion-selective field-effect transistor required the smallest samples, and those gas-sensitive minianalyzers that included a pH-metric solid-contact electrode with a polyvinyl chloride membrane proved the least expensive, most convenient, and simplest for series of analyses. In the case of the biospecific minianalyzers, the detection limit and range of measurable concentrations of substrate were totally dictated by the properties of the potentiometric transistor used to manufacture the minianalyzer. All other analytic characteristics of the biospecific minianalyzers depended on the properties of the biospecific membrane. Tables 4; references 10: 8 Russian, 2 Western.

Russia: Use of the Method of Chemical Decomposition in Analyzing the Distribution of Impurities in Ultradisperse Diamond

964D0606B Moscow ZHURNAL ANALITICHESKOY KHIMII in Russian Dec 95 Vol 50 No 12, pp 1304-1306

[Article by G.A. Chiganova, Physics of Highly Disperse Materials Department, Krasnoyarsk Research Center, Siberian Department, Russian Academy of Sciences, Krasnoyarsk; manuscript received 14 Mar 94; UDC 543.73:666.233]

[FBIS Summary] A study examined the use of the method of chemical decomposition to analyze the distribution of impurities in ultradisperse diamonds. Ultradisperse diamond powder was produced by detonation synthesis. After the ultradisperse diamond powder had been separated from the explosion products by thermal oxidation (using the oxygen in air) of the nondiamond carbon, it was treated with diluted HNO_3 and HCl, rinsed with water until a neutral reaction was achieved, and dried at 383 K. An AAS-1N (Germany) atomic-absorption spectrometer (acetylene-nitrogen oxide and acetylene-air flames) was used to detect the microimpurities present in the powders. An elemental analysis of the ultradisperse diamond's surface was performed by x-ray photoelectron spectroscopy on an ESCA-3. The level of carbon in the ultradisperse diamond was determined by the standard method based on the amount of carbon dioxide evolved when an exact weighted amount of sample was burned. The levels of Ca, Fe, and Cu in the sample of ultradisperse diamond were determined by reducing 1 g of sample to ash at 1,073 K in platinum crucibles and melting the residue with 0.5 g of Na_2CO_3, dissolving the melt in 100 ml of 7 percent HCl, and determining the amount of elements in the resultant solution by atomic-absorption spectrometry with an error not exceeding 1×10^{-4} percent. Quantities of 3 g of ultradisperse diamond were decomposed by oxidation in 150 ml of a mixture of concentrated H_2SO_4 and HNO_3 in a 2:1 ratio in a thermostatted glass vessel at 433 +/- 5 K. The samples thus obtained were then boiled with 10 percent HCl for 15 minutes and rinsed with water until a neutral reaction was achieved. The residues were dried at 383 K and weighed. The degree of decomposition as a result of oxidation and the degree of dissolution of each of the three aforesaid impurities were estimated by formulas provided. The proposed technique of gradual chemical decomposition combined with atomic-absorption spectrometry was de-

termined to be extremely promising for determining the composition and distribution of impurities throughout ultradisperse diamonds. The study samples of ultradisperse diamond were found to contain calcium in a concentration of approximately 0.24 percent by volume in the form of a surface compound and in a concentration of approximately 0.16 percent in the form of a separate phase. They also contained copper in a concentration of 0.02 percent in the form of a surface contaminant and iron in a concentration of approximately 0.12 percent in the form of interstitial impurities and approximately 0.06 percent in the form of a separate phase. Figures 2; references 5 (Russian).

Russia: Determining Triglycerides, Glycerol, and Adenosine Triphosphate by a Polyenzyme Biosensor

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Vol 50 No 12, pp 1318-1323

[Article by V.A. Laurinavichyus, R.A. Tsitsenene, B.S. Kurtinaytene, R.Yu. Meshkis, L.Yu. Martsinkyavichene, and I.V. Bakhmatova, Biochemistry Institute, Vilnius, Lithuania; manuscript received 12 May 93; UDC 577.15.08]

[FBIS Summary] The feasibility of using an immobilized enzyme-based biosensor analytic system to detect triglycerides and their metabolites in blood was examined in a series of experiments involving a device created from the commercially manufactured Eksan-G glucose analyzer and a 1-ml cell equipped with a magnetic stirrer and peristaltic pump. A sensor for determining H_2O_2 that consisted of a platinum electrode and silver chloride standard electrode was mounted in the cell's wall. A semipermeable multilayer membrane containing immobilized glycerol kinase and glycerophosphate oxidase was fixed to the sensor's surface. The glutaraldehyde method was used to immobilize the enzymes in the semipermeable membrane. The electrode's stationary current was registered by using an OH-814 automatic-recording potentiometer (Padelkis, Hungary). The following enzymes were used: lipase from *Pseudomonas* sp. (activity, 250-300 U/ml); glycerol kinase from *Escherichia coli* (activity, 50 U/ml); and α-glycerophosphate oxidase from *Enterococcus* sp. (activity, 60 U/ml). The determination was performed in a 0.01 M phosphate buffer solution (pH 7.2) containing 0.1 M KCl, 3 mA adenosine triphosphate [ATP], and 3 mM $MgCl_2$. Olive oil was used to plot the calibration curves. Glycerol was determined in the cell by adding a buffer solution of glycerol to the buffer solution containing the KCL, ATP, and $MgCl_2$ and measuring the stationary current. To determine ATP, a buffer ATP solution was added to a buffer solution of 0.1 M KCl, 3 mM $MgCl_2$, and 2 mM glycerol, and the stationary current was determined. Correlation studies were performed with human blood serum containing high (6 mM) and normal (0.8 mM) concentrations of triglycerides. The process of determining triglycerides in the polyenzyme system was divided into two stages: (1) a homogeneous stage in which the triglycerides were hydrolyzed by soluble lipase and (2) a heterogeneous stage implemented on a semipermeable membrane containing immobilized glycerolphosphate kinase and glycerol-1-phosphate oxidase. The glycerol formed as a result of homogeneous hydrolysis of the triglycerides diffused into the semipermeable membrane, where it was phosphorylated and oxidized. The resultant H_2O_2 oxidized on the platinum electrode's surface. The increase in the anodic current was proportional to the concentration of triglycerides in the study medium. The electrode current's dependence on the concentration of triglycerides, glycerol, glycerolphosphate, and ATP remained linear to 1.5 mM, 0.3 mM, 0.6 mM, and 0.8 mM, respectively. Between 2 and 3 minutes was required to perform an analysis with the proposed polyenzyme system, and the enzyme membrane remained usable for 1 week. At temperatures of +2 to 4°C, the enzyme membranes retained 10 percent of their initial activity for 5-6 months. Figures 5; references 15: 5 Russian, 10 Western.

Russia: Effect of Medium on Complexing Properties of Immobilized Crown Ethers

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[Article by Ye.I. Grigoryev, S.V. Nesterov, and L.I. Trakhtenberg, Russian Federation Physicochemical State Research Center Scientific-Research Institute imeni L.Ya. Karpov, Moscow; manuscript received 20 Jul 94; UDC 541.64+541.183+542.62]

[FBIS Summary] Published data on the effect of acidity of the medium on the complexing ability of immobilized crown ethers and cooperative binding of cations were reviewed and systematized. The following aspects of the topic were given special attention: kinetics of complex formation; complex formation under conditions of protonation of the macrocycle; effect of acidity of the medium on efficiency of complex formation and selectivity or sorption; charging of the surface; synergism of complex formation in acidic media; formation of complexes with a 1:2 composition; and impact of the matrix effect on selectivity of complex formation. Among the main conclusions of the review were the following: Immobilizing crown ethers may significantly alter their mechanisms of complex formation because of (1) the effect of the surface on the structure and proper-

ties of the ligand and (2) alteration of the conditions of solvation. In general, the cation-binding ability of immobilized crown ethers decreases as the acidity of the medium increases. That decrease has generally been explained by protonation of the macrocycles. In a number of cases, however, the cation-binding ability of immobilized crown ethers increases as the acidity of the solution increases. That increase may be due to several factors, including reaction of the macrocycle with the acid and complexing of the metal in anionic form. Little research has been conducted on the effect of "complex-forming" acids on the cation-binding ability of crown ethers. Synergism of the complex formation of Sr^{2+} ions with the crown ether DTsG18K6 immobilized on SiO_2 in nitric acid solutions has been reported; when the nitric acid was replaced by hydrochloric acid, the cation-biding ability of the crown ether decreased as the acidity of the medium increased on account of protonation of the ligand. Another team of scientists reported an increase in the ability of one crown ether to form complexes with lead cations and synergism of the said cation's extraction in the presence of trichloroacetic acid, and yet another team of scientists reported an increase in the sorption of copper cations by another crown ether as the concentration of HNO_3 was increased. The selectivity of the reaction of "free" macrocycles with metal ions may differ significantly from that of grafted macrocycles with metal ions because of the cooperative interaction of the two adjacent immobilized ligand groups with the cation that results in the formation of a complex consisting of two metal cations to one macrocycle (a 2:1 composition). Polymeric crown ethers that are capable of photodimerization have been reported as being very convenient materials for studying the impact of the matrix effect on the selectivity and efficiency of complex formation. The said polymers may be synthesized in two stages, namely, polymerization of monomers containing crown ether groups followed by joining the polymeric crown ethers in double bounds under ultraviolet light. Three such compounds were demonstrated to have a selectivity of separating Cs^+/K^+ cations of 1.6, 2.5, and 3.5, respectively. It was therefore concluded that polymers with prespecified structures and complex-forming abilities may be synthesized by coordinating the macrocycle with a metal cation. Figures 10, tables 6; references 68: 25 Russian, 43 Western.

Russia: Sonoluminescence in Systems With Focused Ultrasound Waves

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[Article by M.A. Margulis, All-Russian Scientific Research Institute of Organic Synthesis, Moscow; manuscript received 20 Mar 95; UDC 543.8]

[FBIS Summary] The problems of studying cavitation phenomena in systems with focused ultrasound waves were examined. Special attention was paid to systems in which a single stable cavitation bubble is formed. The results obtained in experiments based on such systems (including experiments reported by Saksena and Nyborg, Crum and associates, and Barber and Putterman) were discussed critically. Of the results presented, those reported by Barber and Putterman were said to be the most reliable because they used the most effective method of determining the correlation between the moment of the outburst of sonoluminescence relative to the phase of the cavitation bubble's compression (or the phase of the change in light scattering). Specifically, they simultaneously recorded the sum of the luminous flux of the light scattered from an infrared source (wavelength, 632.8 nm) and the emission of sonoluminescence. It was concluded, however, that Barber and Putterman's contention that "sonoluminescence" is emitted approximately at the moment of the bubble's collapse contradicts the results of their own experiments. It was concluded that the emission of light actually occurs when the radius of the cavitation bubble [r'] equals approximately 0.4 of its maximum size, which is nowhere near the point of maximum compression. It was further concluded that the characteristic features of the sonoluminescence spectra in systems with a single stable cavitation bubble may be the result of instrument effects that are characteristic for spectral studies of weak glows (especially the low precision of the calibration systems used with a deuterium lamp in the range of wavelengths from 190 to 300 nm and the strong emission lines of a deuterium lamp that are present in that region of the spectrum above 39C nm). It was stated that focusing systems with a single cavitation bubble should prove to be extremely effective as a way of concentrating energy and attaining high temperatures, and one possible commercial unit for achieving extremely high local temperatures (as high as the point of initiation of a thermonuclear reaction) and using the energy of thermonuclear synthesis was diagrammed and discussed. The unit includes a large levitation cell with cooled piezoceramic converters that are excited by an ultrasound generator. The levitation cell contains hot fluid that is circulated through a closed loop by a pump. The closed loop con-

tains two heat exchangers. The first heat exchanger heats the fluid to the working temperature. The second heat exchanger is located after the levitation cell and is designed to remove part of the energy released inside the cavitation bubbles as a result of a thermonuclear synthesis reaction. Artificial microbubbles with a specified composition are fed into the levitation cell by a special metering device. In the cell, they become stable cavitation bubbles as a result of pulsations. The fluid in the loop is continuously passed through a filter to remove any microinhomogeneities that may become parasitic cavitation nuclei. Any of a number of high-temperature organic coolants may serve as the fluid. The excess energy from the second heat exchanger may be used to produce compressed steam, which may in turn be diverted to a turbine to produce electric power. Figures 3; references 13: 6 Russian, 7 Western.

Russia: Using a Scanning Tunnel Microscope To Study Hydrosols of Ultradisperse Diamond

964D0633A Moscow KOLLOIDNYY ZHURNAL in Russian Vol 58 No 1, Jan-Feb 95 pp 137-139

[Article by S.V. Kukhtetskiy and L.P. Mikhaylenko, Chemistry and Chemicometallurgical Processes Institute, Siberian Department, Russian Academy of Sciences, Krasnoyarsk; manuscript received 9 Mar 95; UDC 537.533.34:541.182]

[FBIS Summary] A procedure was proposed for using scanning tunnel microscopy to study hydrosols of ultradisperse diamond. The hydrosols were prepared by subjecting a weighted portion of ultradisperse diamond powder to ultrasound dispersion in distilled water and then subjecting the resultant suspension to lengthy centrifugation. The centrifugate was a transparent opalescent solution that ranged in color from pale yellow to brown depending on its particle concentration. The ultrasound dispersion and centrifugation resulted in hydrosols that contained more than 10 percent of the starting powder and that remained stable for a year. When dried, the concentrated solution yielded black glassy solid and brittle residues. By transillumination, thin chips of the glass were brown, homogeneous, and free of any noticeable optical defects. An elemental analysis of the glass performed on an REMMA-202 microscope-microanalyzer established that the chips consisted of carbon with a small amount (less than 1 percent) of impurities. An x-ray crystallographic analysis performed on a DRON-4 demonstrated distinct diamond reflexes analogous to the reflexes of the starting ultradisperse diamond powder, thus proving that the resultant hydrosol consisted of diamond powder. A specially developed scanning tunnel microscope equipped with a cell for working in fluids was used to analyze the hydrosols. A fresh surface of pyrolytic graphite served as the substrate, and a tungsten needle (that had been formed electrochemically) with no insulating coating (the proposed analysis method does not require the use of any insulating coating) served as the probe. The study colloidal solution served as the working medium. A special analysis procedure was developed to accommodate the special requirements of scanning tunnel microscopy, specifically, that an image cannot be produced when particles are floating freely in a solution and that aggregation of the study particles when the film of solution dries out must be avoided. Before the analysis, the dry substrate surface was scanned to find a segment without large defects. A drop of the analysis solution was then applied to that spot. As the solution dried, the substrate surface was scanned directly to avoid the formation of islets of colloidal particles under the scanning tunnel microscope's probe. The scanning was performed with direct current at a voltage of 10 mV and a current of 5 nA. The probe had a negative potential. Depending on the rate at which the film dried out, the images of the particles were observed for 10-15 minutes, which was sufficient to obtain several images with good repeatability. After that period, the contrast gradually disappeared. Once the dispersion medium finally dried out, all that remained visible was the ordinary surface of the pyrolytic graphite, just as before the solution had been applied to it. Figures 2; references 3: 2 Russian, 1 Western.

Russia: Study of the Process of Using Different Alkaline Solutions To Etch Small Pores in Polyethylene Terephthalate

964D0633B Moscow KOLLOIDNYY ZHURNAL in Russian Vol 58 No 1, Jan-Feb 95 pp 140-143

[Article by L.I. Samoylova and P.Yu. Apel, Joint Institute for Nuclear Research, Dubna, Moscow Oblast; manuscript received 7 Dec 94; UDC 541.183.4]

[FBIS Summary] An aqueous solution of alkali with a bivalent cation (Ba^{2+}) was used to etch 3.5- and 10-μm-thick polyethylene terephthalate [PETP] films irradiated with accelerated xenon ions (energy, 1 MeV/nucleon) with a U-300 cyclotron to a track density ranging from 1×10^6 to 1×10^7 cm^{-2}. After they had been bombarded with heavy ions, all the study specimens were irradiated with ultraviolet light to boost the sensitivity of their latent tracks. The study specimens were then etched in a conductometric cell as described elsewhere. Different concentrations of aqueous solutions of NaOH, Na_2CO_3, K_2CO_3, and $Ba(OH)_2$ served as etching agents. The results obtained when the conventional etching agent sodium hydroxide (a 1-1 electrolyte) was used to etch small pores were compared with the results obtained when sodium and potassium carbonates

(1-2 electrolytes) served as etching agents. Replacing the sodium cations with potassium ions had virtually no effect on the kinetics of the etching of tracks. When barium hydroxide (a 2-1 electrolyte) was used as the etching agent, however, a sharp increase in etching rate was observed and attributed to more effective screening of the fixed negative electrical charge on the polymer's surface by the barium's bivalent positive ions. The type of electrolyte used as an etching agent was shown to have a direct bearing on the characteristics of the process of etching small pores. The selectivity of etching of tracks in PETP films in 1-1, 1-2, and 2-1 electrolytes was found to decrease in the following series 1-2 > 1-1 > 2-1. Figures 5; references 9: 3 Russian, 6 Western.

Russia: Chernobyl Accident Caused by Earthquake

964D0798A Moscow ROSSIYSKIYE VESTI in Russian 11 Apr 96 p 2

[Article by Natalya Vdovina]

[FBIS Translated Text] A group of scientists of the O. Yu. Shmidt Joint Institute of Earth Physics of the Russian Academy of Sciences (Academician V. N. Strakhov, director) has put forth its own version of what happened on 26 April 1986 at unit four of the Chernobyl atomic power plant. This version differs from the official version. A scientist at the institute, Yevgeniy Barkovskiy, states that the fate of the atomic power plant had already been decided in 1971 when the first stakes were driven into the construction site of the atomic power plant without the necessary geological and geophysical surveying.

"Not even a barn should have been built on the site of block 4!" exclaimed Yevgeniy Vasilyevich Barkovskiy. "To place the Chernobyl atomic power plant in the Dnepr-Pripyat depression — from a geological point of view this is a powerful node of tectonic faults. Unit four of the Chernobyl power plant was placed directly on one of these faults in the Pripyat system. Parts of the intersection of faults are potential zones of earthquake generation, and the seismic effects of these earthquakes pose a direct threat to the Chernobyl atomic power plant. The system to protect such facilities was designed primarily for a condition of seismic "calm," not to fight upheavals.

By the way, back in 1530 the church historical chronicle states that a rather strong earthquake occurred at Chernobyl. However, this fact was not considered in the selection of a site for an atomic power plant. If one considers that in the seventies anomalous axial expansion of the planet began, resulting in an increase in the seismic-tectonic activity on the Russian plain, then the fate of the atomic power plant was predestined. If the tragedy hadn't occurred in 1986 it would have happened later. In 1991 there was again a catastrophe, but in the second unit. Thankfully, the reactor was shut down, but hydrogen blasted one of the turbogenerators.

It would not be the truth to state that in 1986 all had been blissfully calm. A half-year before the accident the Joint Institute of Earth Physics received a letter. Barkovskiy states that in the letter the director of the Chernobyl atomic power plant expressed alarm about the results of geodesic observations which had been made in 1984-1985. They detected significant vertical displacements of the foundations of unit four and benchmarks in the region of the unit. (By the way, this is a clear sign of the start of tectonic deformation in the region.) But then these facts did not disturb the scientific world much, except for the fact that the Ukrainian press had published a number of articles which talked about the low quality of construction of unit four.

Despite the fact that the cause of the disaster of the century has been examined by several commissions, more than a few gaps remain. According to the official version presented by the International Atomic Energy Agency, the "primary cause of the accident was an extremely low-probability combination of disruptions of procedure and the operating mode permitted by the personnel of the unit. In particular, due to a series of poorly prepared experiments. The last tests were done with a new voltage regulation system. Safety issues were expressed purely formally. The director for the tests was an engineer-electric technician, not a specialist on reactors. The person responsible for reactor safety should have been instructed. But the program did not provide for additional safety measures.

According to the statement of scientists from the Joint Institute of Earth Physics, the cause of the accident was an earthquake which occurred approximately 20-23 seconds before the beginning of the destruction of the nuclear reactor in the unit. This is also indicated by seismograms that Barkovskiy has found. At 100-190 kilometers to the west of the Chernobyl atomic power plant there were three special stations of the Comprehensive Seismological Expedition of the Joint Institute for Earth Physics. These were the Norinsk, Podluby, and Glushkovichi stations.

The expert conclusion of the Joint Institute of Earth Physics is that on the night of 25-26 April 1986 all three stations recorded a relatively weak seismic event. The SKM-3-type channels of all three stations recorded it at 23 minutes 38 seconds (local time). The experts tend to indicate that this is nothing other than a local earthquake. The time of the seismic event recorded by the stations of the comprehensive seismological expedition exactly coincide with the low-frequency rumble and strong vibration of the instruments noted by operators. At 1:23:40 the head of the shift at the unit gave the command to press button AZ-5, and the signal from this button would introduce absorbing neutron rods into the core. They moved downward but nine seconds later there was the first strong shock, and the operator saw that the absorber rods had stopped and were only halfway down. According to estimates made using various calculations, the explosion at unit four of the Chernobyl atomic power plant occurred between 1:23:58 and 1:23:60. Thus, one can assume that the described seismic event occurred 20 seconds before the explosion.

Let us follow the chronology of the accident as reckoned by Barkovskiy.

At 1:23:38 there was a rumble and vibration in unit four. Two seconds later button AZ-5 was pressed. At 1:23:49 the first strong shock to the structures occurred. The reactor protection control system stopped, the electric power was cut off to the DREG and lighting, and ceiling tiles fell in the machine room. One could again see light in the rooms and above the unit in the form of a flash. Finally, about 10 seconds later there was a second, stronger shock to the structures. Again a rumble. A flare up to a half-kilometer high was seen over unit four. Massive destruction of facilities, the cupola of the central hall, structures blown up to 1-3 kilometers. Finally at 1:23:59 the Norinsk seismic station recorded a pulse signal. This is interpreted as a gravitational strong pulse propagating along the fault. At 1:39:08-11 the Norinsk station again recorded two pulse signals. At 1:39:16 the operator made an entry into the DREG log "Explosion of reactor..." The employees at unit four were in no way culpable for the explosion of the reactor. It was bad enough that they were forced to work in an extreme situation without instruction. And there was no explosion like that one. The reactor was destroyed and exploded from its foundation.

Based on this information one can conclude that the cause of the disaster was not defects in the construction of unit four, nor personnel error, but an earthquake! It has been established that at this time strong tectonic activity was observed, there were three cyclones over the Dnepr. An expert commission under the direction of Doctor of Physical and Mathematical Sciences Yu. Ya. Kopnichev studied the seismograms and also stated that there actually was 20 seconds before the explosion in the region of the atomic power plant an earthquake with a magnitude of about 3 on the Richter scale. It was also stated that the Chernobyl atomic power plant was located on an ancient deep fault going from the roots into the upper mantle. Unfortunately, no seismological observations had been done to evaluate the seismic activity of this fault prior to the construction of the atomic power plant, states the conclusion of hte commission.

However, not all scientists agree. Despite the irrefutable proof, the Scientific Council on Problems in Engineering Geology, Hydrogeology and Geocryology of the Russian Academy of Sciences, and the Scientific and Technical Council of the Scientific Engineering and Coordination Seismological Center of the Russian Academy of Sciences in their verdict (dated 14 November 1995) immediately doubted whether the seismic events recorded on the seismograms are an earthquake or the explosion. This is a rather strange statement. The seismograms themselves indicate that an earthquake began much earlier than the destruction of the reactor. The conclusion was signed by Academician V. I. Osipov and corresponding member of the Russian Academy of Sciences A. V. Nikolayev. The scientists acknowledge, however, that "confirmation of the current seismic activity of fault in the region of the Chernobyl atomic power plant merit attention."

Russia: Radiation Hazard from Chernobyl Diverted Water

964D0840A Moscow PRAVDA in Russian
16 April 96 p 4

[Article by Vladimir Zakharov, mining engineer]

[FBIS Translated Text] Sooner or later any disaster diminishes in intensity. Only in this tragedy are there no reassuring prospects in the foreseeable future. In 1996 the Chernobyl tragedy marks its tenth anniversary.

Much has been said about many stages of the operations conducted then in the zone. But it seems to me that one of them was accidently forgotten. I'm talking about the Great Wall of Chernobyl, which the cleanup crew erected in the thirty-kilometer zone during the emergency. Trenches a meter and a half wide and up to thirty meters deep were dug and filled with concrete. This inverted wall stands on the right (high) bank of the Pripyat [River] on water-insoluble clay, and its creators thought that it would prevent the runoff of ground water from the accident zone into the Pripyat river and from there into the Dnepr in the spring of 1986 and subsequent years.

At first glance, this seemed completely reasonable: the ground water from the accident zone wouldn't get into the river then. But deprived of its natural runoff, the water began to collect in the soil of the accident zone and emerge onto the surface, expanding its "geography" from year to year.

In and of itself this is a dangerous symptom. But it becomes ominous if one considers that the zone has (according to official data) six burial sites where more than six million cubic meters of radioactive soil and a million and a half cubic meters of metal structures and reinforced concrete pieces are buried. The VECHERNYY KIEV newspaper even published information from independent Ukrainian experts reporting 800 (!) burial sites with a total volume of radiation of 500,000 rems! This amount is enough to annihilate everything living on the vast area of the CIS to the Volga.

But let us take as a base figure the official figures of tons and cubic meters buried in the six burial sites located in the territory of the zone, in which the soil and pieces

are covered only by several sheets of polyethylene film. Many years of experience shows that this film begins to dry out and break up even in shallow earthen trenches after ten to fifteen years, depending on the ground water composition. This occurs everywhere that ground water flows onto the polyethylene film from above. This means that after five or six years the ground water in the zone not only fills the burial site, but it begins to flow from all three sides of the Great Wall of Chernobyl. The consequences of this outflow are easy to imagine!

However, this is only the beginning, because a steady outflow of contaminated water, which will initially occur in the water-bearing layers, will inevitably link up with the flow onto the surface not only in the zone itself, but in many regions tens of kilometers away from the Chernobyl. This in turn will lead to a situation where the atmosphere will begin to have large masses of radioactive evaporations which cyclones and hurricanes will then begin to carry in all directions for hundreds and thousands of kilometers from Chernobyl. This process will be irreversible for many many decades.

How shall we prevent the next act in the Chernobyl tragedy, which in the very near future will have ruinous consequences for people living in the vast territories of Russia, Ukraine, Belarus and other neighboring countries? This article does not claim to have the final solution, but I propose we examine two alternative projects.

The first is the use of the frames of the houses in the abandoned city of Pripyat to create large containers in several microregions. The houses themselves will have all door and window openings cemented over. After two or three such storage facilities are created the burial sites must be uncovered and the radioactive soil removed and hauled to the storage facility and concrete added in layers.

The second is the use of the experience of erecting "inverted walls." Around each of the six burial sites along their external contour, one must place a closed trench a meter to a meter and a half wide to a depth reaching water-resistant clay layers. Only the trench itself and the area above the burial site will need to be cemented to prevent the penetration of precipitation into the burial site.

One frequently heard that the storage of all radioactive wastes of the Chernobyl accident in the ground was the safest and most reliable method. In terms of economy, yes, but not in terms of ecology, because many studies of this subject have proven long ago and clearly that soil may remove only of mechanical impurities from ground water, not radionuclides and heavy metal salts, which are carried in their primordial form for many tens of kilometers. There are no happy exceptions here and there cannot be.

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